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BLEACHING ♦ DYEING ♦ FINISHING ♦ PRINTING

VOLUME 26 | JULY 12, 1937 | NUMBER 14

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THE OBJECTS OF THIS ASSOCIATION ARE:

"To promote increase of knowledge of the application of dyes and chemicals in the Textile Industry.

"To encourage in any practicable ways research work on chemical processes and materials of importance to the Textile Industry.

"To establish for the members channels by which the interchange of professional knowledge among them may be increased."

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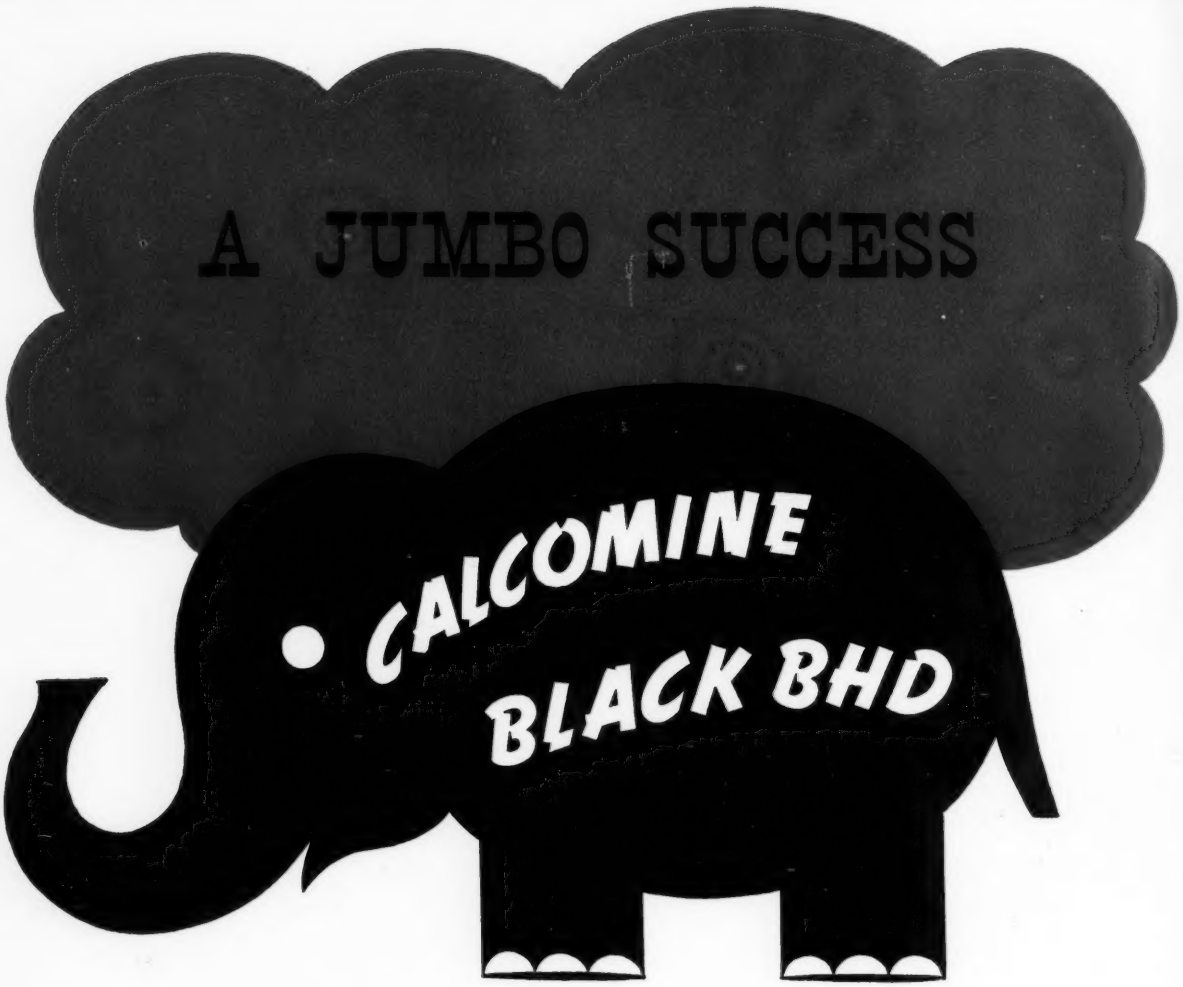

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AMERICAN
DYESTUFF REPORTER

VOL. 26 JULY 12, 1937 NUMBER 14

Oxidation of Finishing Oils

RAYMOND A. PINGREE*

IT is quite impossible to estimate the actual cost to the textile finishing industry from claims and from rehandling of goods, due directly or indirectly to the oxidation of oils or fats used in the finish. No one will dispute the fact, however, that this has always been a major finishing problem. Very little has been published on this subject to enlighten the textile finisher and chemist as to the causes and cures of this trouble.

The purpose of this paper is to outline some of the accepted theories regarding the mechanism and the causes of fat decomposition, methods for determining the extent or the susceptibility to oxidation, and means of preventing or retarding this decomposition.

Wherever the term "oxidation" is used in the following paragraphs it may be taken to mean any spontaneous changes which take place in an oil or fat which produce objectionable fatty or rancid odors or discoloration of the oil or fat in question.

These changes may not be perceptible until after the oil has been in storage for months. On the other hand, these changes may occur so rapidly that they become very noticeable shortly after the finishing oil has been applied and before the goods have left the finishing plant.

MECHANISM OF FAT DECOMPOSITION

Many theories have been advanced concerning the causes and the mechanism of the oxidation of fats and oils. Some of these have come to be accepted as fact, while with others much contradictory evidence seems to exist.

There are three distinct types of fat deterioration—oxidative, hydrolytic and ketonic. Oxidative rancidity consists of the addition of oxygen to the unsaturated glycerides or fatty acids with the formation of moloxides, peroxides or other oxide-like compounds. Hydrolytic rancidity consists of the hydrolysis of the glycerides or other esters with the formation of free fatty acids. Fats or oils containing nitrogenous impurities, such as coconut oil, may develop ketonic rancidity. This results from the action of molds on the lower fatty acids with the production of methyl ketones as end products[10].

* The United States Finishing Co.

Heptaldehyde has been definitely established as one of the cleavage products of fatty oxidation. Upon this fact are based several methods for determining the extent of oxidation.

Roschen and Newton[11] show the oxidation of the triglyceride of stearic and oleic acids as follows:

$$\begin{array}{l} H_2C\text{-}OOC(CH_2)_7CH{:}CH(CH_2)_7CH_3 \\ | \\ HC\text{-}OOC(CH_2)_{16}CH_3 \\ | \\ H_2C\text{-}OOC(CH_2)_{16}CH_3 \end{array} \longrightarrow$$

Glycerol alpha beta distearin gamma olein

$$\begin{array}{l} \quad\quad O\text{—}O \\ \quad\quad | \quad | \\ H_2COOC(CH_2)_7CH.CH(CH_2)_7CH_3 \\ | \\ HCOOC(CH_2)_{16}CH_3 \\ | \\ H_2COOC(CH_2)_{16}CH_3 \end{array} \longrightarrow$$

Peroxide

$$\begin{array}{l} \quad\quad\quad\quad O \mid O \\ \quad\quad\quad\quad || \mid || \\ H_2COOC(CH_2)_7CH \mid CH(CH_2)_7CH_3 \\ | \quad\quad\quad\quad | \\ HCOOC(CH_2)_{16}CH_3 \\ | \\ H_2COOC(CH_2)_{16}CH_3 \end{array}$$

Glycerol alpha beta distearin gamma azeleic semi-aldehyde plus pelargonic aldehyde

Cleavage of the fat molecule undoubtedly proceeds further as indicated by Powick's formula[12] for the oxidation of oleic acid: (See formula at top of next page)

Hydrolysis reactions may be represented by relatively simple equations, as:

$$(R.COO)_3C_3H_5 + 3H_2O \rightarrow C_3H_5(OH)_3 + 3R.COOH$$

fat glyceride — water — glycerine — fatty acid

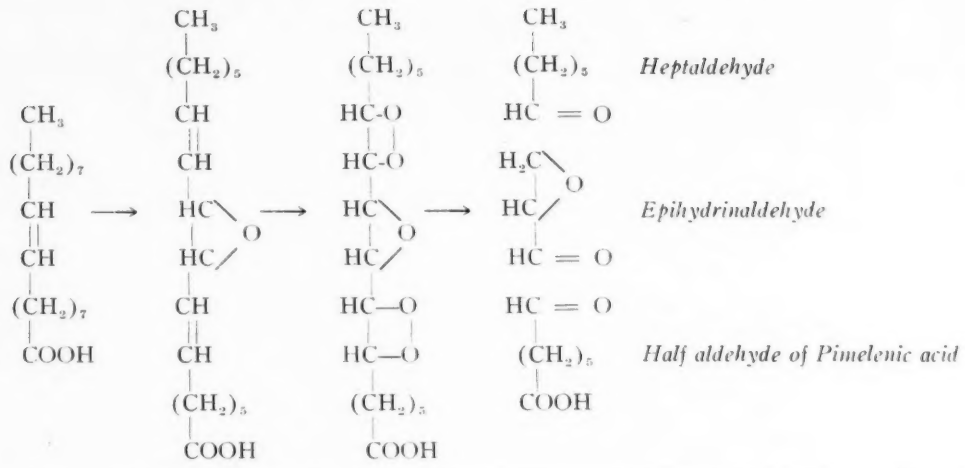
Unsaturated oils under certain conditions undergo oxidative hydrolysis to form hydroxy derivatives. This may be represented, in the case of oleic acid, as follows:

$$CH_3(CH_2)_7CH{:}CH(CH_2)_7COOH + H_2O + \tfrac{1}{2}O_2 \rightarrow$$

water — oxygen

$$CH_3(CH_2)_7CHOH.CHOH(CH_2)_7COOH$$

dihydroxystearic acid



The free fatty acids are more susceptible to oxidation than the neutral glycerides. For this reason the conscientious manufacturer of finishing compounds tries to maintain a minimum concentration of fatty acids in his finished products. Free fatty acids are not only more susceptible to oxidation but they actually function as oxidative catalysts to accelerate the decomposition of neutral glycerides. Spontaneous oxidation of fats and oils is invariably preceded by hydrolytic splitting of the glycerides. Although it is known that fat decomposition proceeds along these lines and results in the formation of fatty acids, hydroxy acids, moloxides, peroxides, aldehydes and ketones at various steps in the process, the constituent or constituents which actually produce discoloration and rancid odors is, or are not known. It is known, however, that in the normal process of oxidation objectionable rancid odors begin to form when the Peroxide Value reaches a certain definite point. This point, for animal fats, is at a Peroxide Value of about 20; while for vegetable fats it is about 100. Peroxide Value is expressed as moles of peroxide per kilogram of fat. Under abnormal storage conditions the Peroxide Value may rise to 80 without showing any trace of rancidity, or on the other hand, under different conditions it may show definite rancidity with a Peroxide Value of not more than 7.

CAUSES OF FAT DECOMPOSITION

One of the principal causes of hydrolysis is the presence of naturally occurring fat splitting enzymes in the fat or oil. These enzymes are present in oleaginous seeds and in animal tissue and may be contained in the commercial oil in relatively large amount, depending upon the care exercised in its separation. In finishing oils which have been subjected to the action of concentrated sulfuric acid hydrolysis may be induced by traces of acid salts or neutralizing alkali left in the finished product. Many sulfonated oil manufacturers take few, if any precautions to minimize hydrolysis in their oils during the sulfonation process. This results in finished products which are often times completely hydrolyzed into the respective fatty acids and are therefore extremely susceptible to oxidation influences.

Hydrolysis, regardless of its cause, requires the presence of air, light or moisture. If enzymes are present moisture alone is needed to promote hydrolysis. This is demonstrated in shipping palm oil in closed casks where it sometimes hydrolyzes to such an extent that glycerine separates out. On the other hand, if fats are fully protected from light, air and moisture they will retain their state of neutrality indefinitely. Friedel[13] found unchanged glycerides in the fatty matter buried several thousand years ago in the tombs of Abydos.

Lewkowitsch defines a rancid oil as one which has been acted on by oxygen of the air in the presence of light. Greenbank[1] found on the other hand that the presence of air or oxygen is not necessary for the oxidation of fats. It has also been shown that oils and fats may develop rancidity in the absence of light. This is especially true if heat and moisture or certain micro-organisms are present. There exists numerous rancidity-producing enzymes, all of which fall into one of three classes; the lipases, which induce hydrolysis; the oxidases and peroxidases, both of which cause oxidation.

It is generally agreed that the effect of air on fats is very slight in the absence of light but has a decided accelerating effect on the oxidation in the presence of light. It has also been shown that the red end of the visible spectrum is most detrimental to fats[2]. Coe and Leclerc[3] found that green wrappers which exclude all light delineated by 4900 to 5000 Å serve to protect fats from oxidation better than most anti-oxidants. The presence of light is also necessary for most fat-splitting and rancidity producing micro-organisms to function, and it has been determined that these organisms require aerobic conditions to live and function[4]. As to the effect of moisture on the oxidation of fats there are many conflicting opinions. Holmes and Greenbank[5] claim that moisture in very small amounts may act as a pro-catalyst. Newton[6] claims that moisture destroys the activity of anti-oxidants

Among the more commonly occurring substances which tend to accelerate or catalyze the oxidation of fats should be mentioned the heavy metals and their salts. Iron compounds in very minute quantities will greatly accelerate fat decomposition. This also is true of chromium, nickel, copper, manganese, lead and many other metals. Aluminum and tin seem to be the least objectionable of all the common metals[7]. The catalytic effect of these metals depends somewhat upon the particular form in which they exist and upon their solubility in the oil or fat. They become most effective when they accur in their highest valence form and combined with an oil-soluble radical such as an aliphatic acid. Commercial use is made of this property of the metals in the manufacture of paints and varnishes where copper, manganese and cobalt soaps are commonly used as so-called "driers" or more properly, oxidation catalysts.

Some organic acids such as succinic, tartaric, citric and lactic act as pro-oxidants. Aromatic acids with a carboxyl group in the side chain exert a similar action, as do also aldehydes and ketones, vanillin and piperonal. Free fatty acids, as mentioned before, have a very decided accelerating effect on fat decomposition.[8]

Another cause of fat oxidation is from the catalytic effect of the naturally occurring carotenoid pigments, carotene, lycopin and xanthophyl.[9]

Although it is true that the presence of air and moisture invariably add considerably to the rate of oxidation, it has also been shown that under normal conditions the oxidation reaction, once it has started, becomes autocatalytic and may proceed to the exclusion of all air and moisture.

ESTIMATION OF RANCIDITY

Many methods have been proposed for determining the extent of, or the susceptibility to, oxidation in fats and oils. The first purely chemical test for rancidity was the Kreis' phloroglucinol test. This test has been modified by Aas[14] as follows: Equal volumes of the sample and concentrated hydrochloric acid are shaken together for thirty seconds. One volume of a 0.5% solution of phloroglucinol in alcohol is added and the shaking continued. After standing 10 to 20 minutes the color intensity of the lower layer is determined with a Rosenheim-Schuster colorimeter and expressed in Lovibond units. The red color is produced by the action of phloroglucinol on epihydrinaldehyde in the fat.

A more recent analytical method for estimating the extent of oxidation is the determination of Peroxide Value. This is accomplished by adding 50cc. of a solution of 2 parts glacial acetic acid and 1 part chloroform (by volume) to a weighed (3 to 10 grams) sample of fat. 1cc. of a saturated solution of potassium iodide is then added, the mixture is kept in the dark for 3 minutes, 50cc. of water is added and it is then titrated with 0.01 normal sodium thiosulfate. The Peroxide Value is expressed as moles of peroxide per kilogram of fat.

Still another test determines the amount of heptaldedyde present in the oil or fat.[15] This is accomplished by dissolving 1 gram of fat in 2 cc. of benzene, shaking for 60 minutes with 20cc. of 0.5 normal sodium bisulfite, centrifuging to break the emulsion and titrating the combined bisulfite in the aqueous layer with 0.002 normal iodine in the presence of sodium bicarbonate.

Many other methods for determining the extent of rancidity have been proposed but these three are the only ones which are now in common use.

For estimating the susceptibility of fats to oxidation influences several methods have been devised. One of these depends upon the rate of volatile aldehyde formation.[16] Another method follows the oxidation reaction by noting the rate of methylene blue reduction.[17] Wheeler[18] has arrived at some interesting results by aging oils under rigidly controlled conditions and following the amount of peroxide formation.

For determining the susceptibility of finishing compounds to oxidation, the writer has found the following procedure very satisfactory[19]: A piece of clean, white cloth, 4 inches wide by 24 inches long, is padded through an aqueous solution of the oil, which should contain actually 7.5% of fatty matter. The strip is then folded and rolled up so that it will fit into a 4-ounce, screw-cap jar. The cap is screwed on tight and the jar is placed in a constant-temperature oven at 50°C. for a period of two weeks. During this time the cap is removed for a minute or two once every day to insure an ample supply of oxygen at all times. If, at the end of this period the cloth has not developed any rancid odor or showed any tendency to yellow or darken in any way, the finishing compound is considered perfectly safe to use.

PREVENTION OF FAT DECOMPOSITION

All oils and fats in the raw state contain natural anti-oxidants which tend to prevent the oil from turning rancid. During the refining operations these naturally occurring anti-oxidants may or may not be removed. If they are removed, then the refined oil will be more susceptible to oxidation influences than the original raw oil.

A great many substances have been found to exhibit anti-oxidative properties when incorporated in various oils or fats. These anti-oxidants in some instances will inhibit oxidation to a remarkable extent. Substances, however, which prove to be very effective in one oil may have little or no effect when combined with another oil. The anti-oxidants are, indeed, very selective in nature. These anti-oxidants, in no case, will prevent indefinitely the oxidation of an oil or fat. They serve only to lengthen the so-called "induction period" of the oil. During the induction period very little oxygen is absorbed. This is due, undoubtedly, to the time required for the dissolved anti-oxidants to react with the pro-oxidant substances present. As mentioned before, this induction period may be considerably lengthened by the addition of suitable

anti-oxidants to the oil, but the subsequent rate of oxidation is never altered.

The following list includes all of the common anti-oxidants which have proved of value when used with certain oils or fats:

Adrenaline
Stearin esters of pyrogallol
Dihydroxynaphthalene[20]
Phenyl phenolate[21]
Cyanamide compounds
Thymol
Phenol
Naphthols
Polyhydric phenol derivatives
Guaiacum gum[26]
Unsaturated polybasic acids[27]
Diaryl alkanes, ethers and amines[29]
p-Hydroxydiphenylmethane[28]
Hydrogenated sesame oil[30]
Meso-disubstituted acridan[31]
Oat and Soybean flour[32]
Chlorinated paraffins
Maleic acid[33]
Phthalic acid
Camphor
Hydroquinone
Pyrogallol
Guaiacol
Carotene pigment[22]
Peracetic acid[23]
Sodium thiosulfate[24]
Sucrose[25]
Citric acid
Quercitrin[34]
Tyrosine esters[35]
Lecithin
Aliphatic amino and hydroxy compounds
Glycine[36]
Asparagine
Sodium citrate
Sodium malonate
Diphenylamine
Catechol
Hydroxyhydroquinone
Citraconic acid
Itaconic acid
Alkali metal oxalates[37]
Magnesium oxide[38]
Amino sulfonic acids[39]
Pyrocatechol
Substances having a phenolic group

The manufacturer of finishing oils has at his disposal several means of producing a finished product which will be resistant to oxidation influences. First of all, he should be very careful in his choice of raw material. He should use products which have been carefully and properly refined under rigidly controlled conditions. The raw oil or fat should have a zero Peroxide Value, should be light in color, indicating a minimum of organic impurities which might act as pro-oxidants, and it should show the proper Iodine Value for the type of sulfonation or treatment for which it is intended. Secondly, the sulfuric acid and all other chemicals which are used in the manufacturing process should be carefully checked for the presence of heavy metals, especially iron, which is most commonly found as an impurity and which should be rigidly guarded against. Thirdly, the manufacturing conditions should be so controlled that there is a minimum amount of side reactions or breaking down of the carbon chain. Lastly, proper precautions should be taken to use the proper preservatives and anti-oxidants which are adapted to the oil or fat in question. It is a relatively simple matter to guard against bacterial or enzymic decomposition in a finishing compound. This is readily taken care of by the addition of a small amount of formaldehyde or other antiseptic. The protection against other oxidative influences is not a simple matter, however. The choice of an anti-oxidant should be made only after a thorough investigation of all possible compounds which possess anti-oxygenic properties.

The Iodine Value of an oil is generally an index of its tendency to oxidize. With sulfonated oils, however, this does not necessarily hold true. First of all the amount of unsaturation may be reduced to a decided extent by properly controlled sulfonation; and secondly the oxidation tendency of the finished product may be still further reduced by the incorporation of the proper anti-oxidants.

A study of the action of various anti-oxygenic substances on a number of sulfonated oils was made some time ago by the author with some very interesting results. In the course of this work it was found that, providing the oils are sulfonated under identical conditions, the tendency to oxidize is directly proportional to the Iodine Value of the original oil. An exception to this rule was found in oils which were composed mainly of fatty acids containing an hydroxyl group. With these oils an increased tendency to oxidize was noticed. By incorporating equivalent amounts of anti-oxidants in all of the sulfonated oils under observation it was found that some of the moderately high Iodine Value oils were improved to such an extent that they showed greater stability than some of the low Iodine Value oils. It was also shown that mixtures of two or more oils often times produces a finished product which was more stable than any of the individual oils treated in the same manner. For instance, a mixture of equal parts of corn oil and olive oil gave a product which was definitely superior to similar products produced from the individual oils. When these sulfonated oils were applied to cloth and allowed to age in jars it was found that those oils which turned rancid most rapidly also showed the greatest amount of discoloration and vice versa.

A comparison was made between the various sulfonated oils containing anti-oxidants and a good grade of commercial olive oil sulfonated under the same conditions but containing no added anti-oxidant. It was found that the following oils were fully as stable as the olive oil: corn, neatsfoot, peanut, rapeseed, sesame, soya and tea seed. Comparing these oils with a sulfonated olive oil containing an anti-oxidant it was found that peanut oil and tea seed oil were equal if not superior to it. Mixtures of olive and corn oils (1:1) tea seed, corn and peanut oils (1:1:1), and tea seed and cottonseed oils (1:1) were all equivalent to olive alone.

It would seem from this work that there should be little difficulty in finding substitutes for olive oil which would be fully as satisfactory if not actually superior for use in finishing of textile fabrics.

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WASHINGTON NEWS LETTER

WALDON FAWCETT

DESIGN AS A FACTOR IN FAIR TRADE

SHIFTING so quietly that its significance has been missed by many participants and onlookers, there is now in transition the status of the legal security of the most valuable intangible assets of business. Colorists are directly and indirectly concerned in a transformation that is signaled by legislation already enacted in many individual States and by Bills pending in both houses of Congress. Attention has but lately been focused on the latter aspect by President Roosevelt's suggestion that the Miller-Tydings Bill be held in abeyance and by the protest at postponement by leading trade associations.

Dual reversals of policy characterize the current rearrangements in behalf of the capitalization of individuality in industry. On the one hand, a new approach to a long-coveted goal. On the other hand a new selection of immediate objective. The new approach is expressed by legislative strategy which switches initiative from Washington to the several State Capitols. The revision of objective slants a perennial conservation movement to the control or attainment of Fair Trade, so called, rather than the earlier ideals expressed in efforts for Resale Price Fixing, Design Protection, etc.

Undoubtedly industry has to thank, for this new vehicle, and its altered route, the NRA of the New Deal era and its collateral system of voluntary, cooperative codes of fair competition. The new spirit in industry seeks to accomplish by Fair Trade compulsion, the retail price stabilization and mutual respect for creative originality which have been sought in a long succession of legislative proposals. And, pending a reconstruction of the NRA or equivalent institution at Washington an approach to the new basis of contractural relations (as between producers and marketers of identified commodities) has been made via the State legislatures. Impetus has been added, unquestionably by the recent decision of the U. S. Supreme Court upholding the constitutionality of the Illinois and California State laws of Fair Trade. And by a coincident realization in industry that State laws, whatever their sufficiency for intrastate commerce need the backing in interstate commerce of a Federal Enabling Act.

All of these seemingly remote developments are brought more intimately in contact with the dyestuffs industry and textile chemistry circles by the reaction upon design. It is an open secret at Washington that the lack of activity in the 75th Congress in respect to the inherited proposals for Design Copyright, Design Registration, etc. is in part explained by a disposition in Congress to mark time on all proposals for grants of monopolies or priorities in the appearance or designation of commodities until the possibilities of Fair Trade regulation may be explored. Meanwhile there looms yet another complication, inherent in national adoption of any system of fair trade enforcement—bureaucratic rivalry. A hint of what impends in this quarter is found in the current contest as between the U. S. Food and Drug Administration and the Federal Trade Commission for the position of censor under the projected revision of the Food and Drug Act.

It has remained, by the by, for the Federal Trade Commission to disclose, even at this intermediate stage of evolution, the possibilities of mandatory policies that must ultimately concern all interests that supply color for ornamentation or identification in industry. The Trade Commission, as our readers know, has challenged organized collective action to enforce respect for originality or creative expression in design. And the challenge has been taken up, most recently, by the Millinery Quality Guild. The outcome of a clear-cut test case, carried to the highest Federal court, should do much to determine the future weight of design (and color in design) as a factor in trade.

Disciplinary action by the Federal Trade Commission, which the Millinery Guild is resisting and, in a sense, ignoring for the time being, is of moment to the entire textile trade and related industries because it is based to a considerable extent upon the maintenance by the Millinery Quality Guild, Inc., of a department known as the "Registration Bureau" wherein members of the Guild and no others register their original designs or models. The avowed purpose of the Guild was to prevent piracy and design. The Trade Commission charged that the actual tendency and result was to restrain commerce by limitation of outlets or sources of supply and to increase prices to the consuming public. The current action by the Trade Commission parallels earlier procedure in kind against the Fashion Originators Guild of America, the National Federation of Textiles, and affiliated organizations.

While the matter of judicial review of the Federal Trade Commission's action is of moment, even deeper curiosity attaches to the effect upon the Trade Commission program of legislation prescribing rules for fair trade. In its actions to date the police authority is taking to itself the powers and duties which it claims are conferred by the Federal Trade Commission Act. A complete set-up of Federal and State laws of Fair Trade would, presumably, supplant the existing legal structure, at least to the extent of defining in detail the allowed and disallowed practices of fair trade and thereby rendering it the easier to relate the approved principles to design and to color as an instrument or medium of creative design.

By and large, any new instrumentality of design security should be worthy of examination in any industry dependent upon designs, however rendered. In the case, however, of the Fair Trade accession not the least of the urge to exploration arises from the breadth of application or versatility of the new agency. As our readers know, such forms of design protection as now exist are circumscribed in application. Design patent, for example, is restricted to actual invention, in contrast to originality of treatment. Registration of technical trade marks accords no right in color as such. Copyright of labels and prints is no more than Governmental certification of a claim of priority or private ownership. None of these vehicles affords specific encouragement to the use of color in designing for popular recognition of origin or ownership of goods.

In contrast to these limitations is the somewhat broader protective sweep of the Fair Trade formula which recognizes a varied category of clues, within or superimposed upon goods, as a basis of resale price control by contract exempt from the anti-trust laws. The wording of the Miller-Tydings bill, following the model statute approved in upward of half the States of the Union, makes eligible trade marks, brands, and names (surname, corporate name, etc.), as credentials for the price-fixer. More to the point of extension of scope, it embraces labels and containers which bear commercial finger-prints or the signatures of producers or distributors.

No representation is, of course, intended that any version of the Fair Trade legislation now to the fore directly affords of itself any independent protection for designs as such. Such gain as there is by this new turn of events is in terms of moral effect. Indirectly and inferentially the Fair Trade contract system tends to bring fuller recognition of the contribution of markings and design to modern commerce. And just in proportion as this recognition is deepened will ground be solidified for the more effective protection of original design under the common law. In other words the value of design—and, with it, color plans, etc.—is increased as design, preferably in color, becomes the passport to price regulation.

While the protection of design, as such, is not in the lexicon of the Fair Trade reformers, their most loudly avowed purpose is, of itself yet another contribution to warfare against design piracy. The main argument in all State and national campaigns for Fair Trade legislation is that the legalizing of price contracts would operate to end the evils of the "loss leaders" which have reached such proportions in fields not far removed from textile circles. The loss leader, being defined as bargain-baited merchandise offered to the public at a price less than the cost of production.

Taking the loss-leader indictment at face value there is an unmistakable community of interest between the cut-price evil and design protection. In the textile field in particular one of the immoralities of the loss-leader abuse is that, in the desire to obtain maximum appeal in this species of promotional goods, the purveyors have been under strong incentative to raid the exclusive or unusual designs which are most in vogue at the season. Just in proportion as loss-leaders are discouraged there should be less temptation for design piracy victimizing style leaders.

Watch for the first

QUARTERLY

RESEARCH REPORTS

They will appear in the Proceedings of the American Association of Textile Chemists and Colorists as published in the July 26th issue of

AMERICAN DYESTUFF REPORTER

Official Organ of the A.A.T.C.C.

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

JULY 12, 1937

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Members should notify the **Secretary** immediately of all address changes

MEETING, SOUTHEASTERN SECTION

THE regular spring meeting of the Southeastern Section was held at the Thomas Hotel, Auburn, Alabama, Saturday, April 24. During the afternoon a number of members visited the Textile Building of the Alabama Polytechnic Institute. The usual informal dinner was held at 7:00 P. M. E. A. Feimster, Jr., presided at the meeting which followed. Professor R. B. Draughton, in the absence of President Duncan, extended a welcome in behalf of Auburn.

A motion was made, seconded, and passed that the fall meeting be held in LaGrange, Georgia. Mr. Feimster appointed the following committee to arrange for the fall meeting: M. T. Johnson, J. M. Youngblood, and A. R. Macormac. The following committee was appointed to prepare for the 1938 Annual Meeting, which is to be held in this Section: C. A. Jones, S. I. Parker, W. F. Crayton, L. L. Bamberger, and A. R. Macormac.

There being no further business to come before the meeting, the following technical program was presented:

"Control of Variables in Raw Stock Dyeing," J. H. O'Neill, Overseer of Rawstock Dyeing, Eagle & Phoenix Mills, Columbus, Ga.

"Analysis of Machinery and Its Proper Location in Modern Plant Design with Special Reference to Raw Stock Dyeing Machines," Prof. A. L. Thomas, Prof. of Engineering Drawing, Alabama Polytechnic Institute, Auburn, Alabama.

Various points in these papers were discussed by different members. Following this discussion, Mr. Paul K. McKenney, President of Swift Manufacturing Company, Columbus, Georgia, gave a humorous and inspirational talk based on his experiences in the textile industry.

About seventy members and guests were present.

Respectfully submitted,

A. R. MACORMAC, *Secretary.*

Dyes—How They Are Made*

C. SCOTT ALTHOUSE†

BETTER than 95 per cent of the dyestuff used in the world today is of synthetic origin. Practically all of these synthetic dyes are made from coal tar. I intend to confine what I have to say to this class of coal tar dyes, and hope, in an elementary way, to show you something of their fabrication.

Their basic source, as the name implies, is coal tar. This substance for years was an unwanted by-product from gas works and coke ovens. It was more than a nuisance. Gas companies had great difficulty in disposing of it, yet this mean, sticky, black tar contains, all of the beautiful colors known to the dyer's art, as well as the best of our modern pharmaceutical preparations, and a multiplicity of chemicals which make possible many of our commercial arts, such as the production of bakelite and similar synthetics.

A brief review of the production of coal tar is not out of place even though many of you are undoubtedly familiar with it. Coal is heated in the absence of air to make coke. During this heating much gas is liberated from the coal. This gas contains chiefly illuminating gas, ammonia, and coal tar. These components are separated by suitable processing and the coal tar is ready for treatment.

Coal tar is composed of several organic compounds. Some of them are liquid, some are solid. The mixture is a dark plastic mass. It is roughly broken down into its separate components by the process of fractional distillation, followed by chemical purification, and usually a final distillation.

This fractional distillation is very similar to the distillation of petroleum oil, therefore, I will compare the various distillates from coal tar to those of petroleum oil, as I believe this comparison will serve to give you a fair picture of how we get the crude products for the manufacture of dyestuffs. The products of petroleum distillation are familiar to all of us. Obviously, any comparison between coal tar distillation, and petroleum oil distillation must be very crude, and I will not attempt to enter fine details as my purpose is only to give you a rough idea of the origin of the materials used for dye making.

The separation of the various compounds in fractional distillation depends on the fact that these products have different boiling points, therefore, the ones with the lower boiling points will come off first, and as the temperature rises the various higher boiling point compounds distill off. This is true with both coal tar and petroleum oil distillation. It must be borne in mind that the first distillation of these products is not pure and, therefore, need subsequent separations, and purifications. In the first heating of both coal tar and petroleum oil there are given off some worthless gases. The first products of value from coal tar are: benzene, toluene, and xylene. These correspond to gasoline and kerosene in crude oil distillation, and come off below 200° C. and when this distillation is complete the temperature is raised, and we next procure naphthalene, carbolic acid, and the cresols. These correspond to lubricating oils and vaseline from petroleum oil distillation. After this fraction has been completed the distillation is usually stopped and the residue is the familiar road oil, or tar used for binding macadam roads. In dyestuff manufacturing benzene, toluene, and naphthalene are the most important, and it is for this reason that the distillation is usually stopped after the naphthalene, however, the residue also contains anthracene which corresponds to paraffin in the petroleum oil distillation. While anthracene is not as much in demand as either naphthalene or benzene, some of the distillation is continued and this product removed, in which case the final residue is the hard pitch with which you are familiar. It is used to make slag roofs. Therefore, we have two by-products, the soft pitch for macadam road binding and the harder pitch for slag roofs.

These separate fractions are treated chemically to remove many of the impurities. They are then subjected to a very careful distillation which yields the fairly pure compounds used commercially in the production of dyestuffs. From the first fraction, we obtain technically pure benzene, toluene, and xylene, all of which are liquids. The next two fractions yield only naphthalene which is of interest to the dyestuff chemist. This product is familiar to you for it is sold in most stores as moth flakes or moth balls. The last fraction may be converted to anthraquinone which is the base of many Alizarine and Acetate Rayon dyestuffs.

Benzene is probably the most important of the coal tar distillates. Chemically, it consists of six atoms of carbon and six atoms of hydrogen; however, the organic chemist cannot consider the formula as C_6H_6. It is known that the actual construction of the benzene molecule consists of a continuous linkage of the six carbon atoms and to each of these is linked an atom of hydrogen. This structure is symbolized by a six-sided ring. It is understood that each corner of the ring symbolizes a carbon and a hydro-

*Presented at meeting, Piedmont Section, April 17, 1937.
†Althouse Chemical Co.

gen atom. In this structure, the carbon atoms are permanent, but the hydrogen atoms may be substituted by other atoms such as chlorine or bromine, or they may be substituted by a group of atoms such as the nitro group (NO_2) or the amino group (NH_2). Furthermore, any or all of the remaining hydrogen atoms in the benzene molecule may be substituted. When this is the case the relative position of these substitutions to one another has a very great effect on the characteristics of the compound. By using the ring symbol, one can show not only the groups substituted, but also the relative position of these groups to one another. The mere change of position of one of these substitution products may have a profound effect in the final dyestuff; changing shade, dyeing properties and fastness properties.

All coal tar distillates have the same type of ring structure as benzene, and therefore, their formula cannot be expressed with a plain symbol. Naphthalene is nearly as important as benzene and consists of 10 parts of carbon and 8 parts of hydrogen ($C_{10}H_8$). This is symbolized as two six-sided rings having a common side. Here too, in naphthalene, as well as in all other coal tar distillates, the carbon is fixed and the position of the substituted hydrogen atoms is as important as it is in Benzene.

When the hydrogen atom is replaced in the coal tar crudes, the compound is called an intermediate. This term undoubtedly was born from the fact that these compounds are intermediate stages in fabricating a dyestuff from coal tar crudes. Some intermediates are simple and easily made, others are extremely complicated. This is the reason for the great differential in the price of dyestuffs.

An illustration of this is Azanol Orange II, a cheap dyestuff, and Anthra Milling Orange CW, a dyestuff worth more than $2.00 per pound. This is only one of the many examples of this broad variation in price. Both of these dyes have approximately the same shade, but they decidedly differ in fastness properties and cost of manufacture.

The chemicals chiefly used to make intermediates are the ordinary heavy chemicals. The most common are: sulfuric acid, nitric acid, muriatic acid, and acetic acid, caustic soda, soda ash, ammonia, and sodium sulfide. Some of the metals, such as iron and zinc, are used in either coarse or dust form. Chlorine and bromine also play an important part.

The same chemicals may produce different compounds from any one of the coal tar distillates, simply by changing the order of treatment or the conditions of treatment. If beta naphthol is sulfonated with a large excess of sulfuric acid at low temperatures, the product is largely a compound known as G acid. If all the conditions are the same except a raised temperature, the product is chiefly a compound, known as R acid. G acid combined with aniline yields an orange; R acid used in this combination gives a red. These varied conditions and order of application of different chemicals are all methods in the production of various intermediates. This applies to all the chemicals as well as to the sulfuric acid illustration just mentioned.

The weight of heavy chemicals in relation to the final product is interesting. I know of several intermediates which require 30 pounds of raw chemicals to produce 1 pound of the final product. Some intermediates are easily and quickly produced while others take weeks. It is easy to see the cause of the great variation in the price of dyestuffs. It has proved painfully true that the more complicated the intermediate the better is the final dye.

It might be of interest to describe the manufacture of some of the simple intermediates.

Benzene is treated with nitric acid. This process, called nitration, yields nitrobenzene which is commercially known as oil of myrbane and has little use except as an odorant to disguise objectionable odors in such products as shoe polish and cheap soaps. The chief use of this product is in the fabrication of other intermediates. When this nitrobenzene is treated with iron filings and common muriatic acid, under proper conditions, and then subsequently separated by steam distillation, the widely known compound aniline is produced. This intermediate is used for the dyeing of oxidized aniline black, but its greatest application is in the simple azo dyestuffs.

If this same nitrobenzene is subjected to the action of zinc dust and caustic soda, a different reduction product results. This particular reduction yields benzidine. While aniline is used in many of the simpler acid colors, benzidine is the base of many direct or cotton dyes. Benzidine can rarely be used to produce an acid color. This is one of the numerous peculiarities which make the production of different dyes possible.

If benzene is given a more severe nitration than that used in making nitrobenzene, we obtain dinitrobenzene. When this compound is treated with fine zinc and acid, metaphenylene diamine is formed. This is called MPD for short. This compound is possibly very familiar to all of you, for along with MTD, it is a popular developer for developed blacks.

Again start with benzene. Sulfonate it with sulfuric acid and fuse the product with caustic soda. Phenol, commonly known as carbolic acid, is produced in this manner. This is an important chemical in the production of dyes and more complicated intermediates. Its use has increased a great deal in the last few years due to the fact that it is one of the chief components of bakelite and other synthetic resins and plastics.

Another very common product originating in carbolic acid is aspirin. This is produced by treating phenol under pressure with carbon dioxide, and the resultant product is subjected to the action of acetic acid. This is only one of hundreds of pharmaceutical preparations, so valuable to the medical profession, which are derived from coal tar.

In turning to toluene we find that it is capable of the same treatment as benzene. While similar treatment pro-

duces similar compounds, they form different shades when combined with the same ultimate compound. MTD or meta toluylene diamine is made from toluene by dinitration and reduction with zinc and acid. When toluene is given a very severe nitration, trinitrotoluene is procured. This is a very powerful explosive, known as TNT. As a matter of fact there are many other explosives manufactured from coal tar derivatives which are far more powerful than the old nitroglycerine.

Medicine also uses many of the derivatives of toluene. The most familiar one is probably saccharine which along with the discovery and development of insulin has been a great boon to the diabetic sufferer.

Like the other coal tar distillates, it is possible to make from naphthalene several hundred dyestuff intermediates. Some of these are simple while others are quite complicated. Naphthalene derivatives are important. They are present in better than 50 per cent of the dyes of commerce.

I have mentioned before that the other distillates of coal tar are subject to similar syntheses. If naphthalene is treated with nitric acid and the resulting nitronaphthalene treated with iron and muriatic acid, we obtain alpha naphthylamine. This in the naphthalene series corresponds to aniline from the benzene series of intermediates. It is a fairly important intermediate but is never used by the dyer. Beta naphthol, the developer with which you are all familiar, is similar to phenol. To produce it, naphthalene is first treated with sulfuric acid and the resulting naphthalene sulfonic acid is fused with caustic soda, in a manner quite similar to the production of carbolic acid from benzene. Since both of these intermediates are well known to you, you can realize the tremendous difference in analogous compounds derived from the different distillates. In the case mentioned above carbolic acid is a very caustic and corrosive product while beta naphthol is very mild. It is even more important as an intermediate than it is as a developer.

H acid is a more complicated compound made from naphthalene yet is one of the most commonly used in the dyestuff industry. Naphthalene is trisulfonated with fuming sulfuric acid and at considerably elevated temperatures. Naphthalene trisulfonic acid is then nitrated with nitric acid and the nitro group reduced to an amino group by an acid reduction with iron. This amino naphthalene trisulfonic is separated then fused with caustic soda. This is typical of the intricate procedures employed in producing a great many of the commonly used intermediates. The true name for this chemical compound is 1 amino, 8 naphthol, 3:6 disulfonic acid. You can readily see why for convenience it is called simply H acid. This short abbreviation is common in the dyestuff chemist's vocabulary. Some of them are: H acid, G salt, BON, PNA, MTD, MPD, TNT, etc.

The above is only a sketchy description of a few of the simpler intermediates. It is interesting to note that from benzene, toluene, naphthalene, and anthracene there are produced the very cheapest, the most fugitive and the poorest dyes as well as the most expensive and the extremely fast dyes.

I wish to emphasize that these simple intermediates have been described not because of their common usage, but rather because they serve as a useful medium to illustrate the steps from coal tar to a dyestuff. I further want to emphasize the fact that the outline of how a dyestuff is produced has been given with great omission of detail. There are actually hundreds of intermediates too complicated for this brief description, and the manifold manner in which they may be combined with one another gives many million possibilities each of which is a dyestuff.

The actual process of combining these intermediates to form a dyestuff, does not lend itself to general explanations. Briefly, the amino group, NH_2 on an intermediate is the reason an Azo dyestuff is possible. Without this amino group we could not couple one intermediate to another for the production of the Azo dyes, and I can better illustrate this principle by making a few of the simple dyes, and I will proceed in a very crude manner to make the Acid colors, Orange II, and Fast Red A, and the cotton color, 2B Blue.

DISCUSSION

Mr. Moss: How do you obtain dyestuffs in the powder form?

Mr. Althouse: To get dyestuffs out of water solution, a great deal of salt is added. Since water can not hold in solution a great deal of salt and dyestuff at the same time, and since water prefers to dissolve salt, the dyestuff is thrown out of solution in small particles which are filtered, dried, ground and typed. This salting out requires large amounts of salt, sometimes saturating the water. It often requires 2,000 lbs. of salt to precipitate 1,000 lbs. of dyestuff. This salt is all lost going down the sewer in the filtrate.

Mr. Seibert: How do you arrive at the standardization of different colors?

Mr. Althouse: After the dyes are filter-pressed, dried and ground a sample is sent to the standardizing laboratory. The dye is standardized by dyeing for there is no other way that is accurate. For instance the intensity of color of a water solution is not a dependable basis of typing. The strength of the tested lot is established by dyeing a series of different strengths and comparing the dyeings with known strengths of the standard.

Mr. Seibert: Suppose a lot is off shade. How is that standardized?

Mr. Althouse: Careful manufacturing control makes off shade lots a more rare occurrence than is generally

supposed. When it does happen it is either shaded with dyes of the same dyeing characteristics or it is held until a lot of the same color which is slightly off shade on the opposite direction is obtained to mix with it.

Mr. Seibert: Isn't it possible to type dyes in the tub while they are in water solution?

Mr. Althouse: That is not feasible. The chief reason being that such a typing would include all of the impurities and side reactions that normally are separated from the dyestuff during the filtration. Filtration greatly purifies dyestuffs for many impurities are in the filtrate which goes down the sewer.

Mr. Bruce: Don't you sometimes hold a lot that is off shade until you might get another to match it?

Mr. Althouse: We sometimes do that. More often we hold it until we make one that will counteract it. We usually can do this intentionally. For instance, if a lot of 2B Blue is slightly red it could be held until a lot that is slightly blue is made. A mixture of the two lots would then be standard type. To cancel any deviation from type we make it a practice to manufacture a number of lots at one time. When these are mixed together along with the stock of that color which is on the floor we have very little difficulty in maintaining standard type material. While one lot may differ slightly from another, a mixture of eight lots will be identical to a mixture of another eight lots.

American Dyestuff Reporter 26 #14 July 12, 1937

Whole Cotton Project*

A. R. MACORMAC, Ph.D.†

GENTLEMEN, it is not my purpose this afternoon to present any new data nor to make this talk of mine a scientific paper in the ordinary sense of the term. I am one of a group of men who during the past 8 years have been carrying on a scientific investigation upon a product which is of vital importance to everyone present. This work has been done entirely within the State of North Carolina and for the most part, by North Carolinians. The Piedmont Section of the A. A. T. C. & C. is the scientific association which reaches the greatest number of scientists and technically trained men in the industries in this region. I welcome this opportunity to tell you the story of this investigation and incidentally to get together with my many friends in both Greensboro and the Piedmont Section. I hope that my story will be of interest to you.

For that is what I plan to do this afternoon, simply to tell a story. If I am going to tell a story—even though it isn't a fairy story, I suppose it is the proper thing to start with Once upon a time back around 1928-9 when cotton was selling for 5c a pound, there was a college professor lecturing to a class in industrial chemistry. He happened to be talking about the manufacture of soda ash and in comparing the older LeBlanc with the more recent Solvay process said, "If it had not been for the increased demand for bleaching powder and chlorine which are byproducts of the LeBlanc process, this method of making soda ash would have been abandoned long ago as uneconomical. Thus an industrial material or process which is used for one purpose at one time may at some future time be used for an entirely different purpose. For example, consider cotton." At the mention of cotton several members of the class showed more signs of life. What, they wondered, was the connection between cotton and soda ash. The professor goes on—"We have for generations cultivated the cotton plant as a source of a fiber, lint, cotton, but it is not improbable that with the present low price of lint cotton and the increasing demand for cellulose for so many purposes that it would be more profitable to raise cotton as a source of cellulose rather than as a source of a textile fiber." That chance remark lodged itself in the mind of one of the students in that class and has remained there in an active form up to the present time, and will probably continue to be a ruling factor in Mr. Dockery's action. For the professor in this incident was Dr. Cameron and the student Mr. Nicholas Dockery, of Rockingham, North Carolina.

Some few days later, after pondering the matter over in his own mind, Mr. Dockery went to Dr. Cameron. He asked, "Dr. Cameron, are you serious about the idea of using cotton as a source of alpha cellulose?"

Dr. Cameron replied, "Yes. It is entirely possible that considering the time and other factors involved, cellulose could be obtained as cheaply from the cotton plant as from any other source. I don't know, but I believe it is worthwhile looking into."

"Well," said Nick, "I would like to work on it."

"Fine," Dr. Cameron replied, "The very first thing to do is to find how much cellulose there really is in the cotton plant."

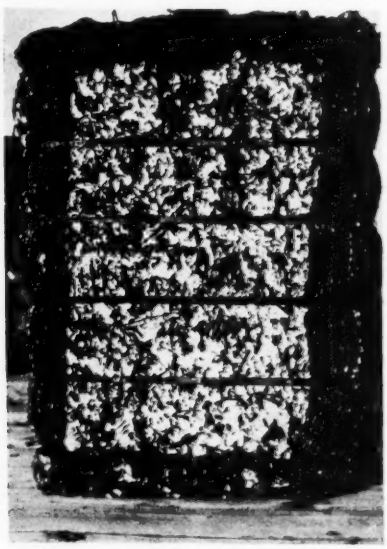
* Presented at meeting, Piedmont Section, April 17, 1937.
† Alabama Polytechnic Institute.

Laboratory at Chapel Hill showing the Digester and other Apparatus.

Hammer Mill Used for Ginning the Whole Cotton.

Courtesy John Deere Co.

Harvesting the Whole Cotton. This is the combined reaper and baler used in 1936.



Baled Whole Cotton. This Bale is the Size of the Usual Cotton Bale.

The next week-end Dockery went home to Rockingham and collected specimens of the cotton plant, bolls and all, and brought them back to Chapel Hill. During that winter of 1929-30 he worked on the analysis of the whole cotton plant and found it contained about 55% cellulose. When it is considered that wood pulp yields only about 45-50% cellulose, these results were very encouraging. Results of the succeeding years check very closely with these figures. Of course it is not to be inferred that a 55% yield of alpha cellulose can be obtained from the cotton plant. This 55% cellulose is the sum of the alpha, beta, and gamma cellulose as obtained by methods given in Griffin Technical Methods of Analysis.

Encouraged by these first fruits of their labors, Dr. Cameron and Mr. Dockery planned a regular campaign during the Spring and Summer of 1930. Their main object was to determine the best time to harvest the cotton plant in order to get the maximum yield of cellulose. Experimental plots were planted in several different types of soil and weekly samples taken from the 10th week on. These samples were analyzed for moisture, cellulose, fats and resins, and ash. The results will be shown later on a slide. Briefly they indicated that the maximum cellulose and the minimum water content was reached at about the 26th week from the time of planting. When the analyses showed that the cellulose content had reached an approximate maximum the crop was cut partly by hand and partly with a mule drawn mowing machine. The whole plant

was then baled. In some cases the bales were covered with burlap and were the size of the ordinary 500 lb. cotton bale. Other bales were the size of the usual 125 lb. hay bales and held together with wire. At the time the cotton was cut and baled practically all the leaves had fallen off. Thus the baled whole cotton plant consisted of the woody stems, the bolls or cusps, and the seed cotton. One of the impressive things to me when I first saw these bales was the large amount of seed cotton present. This is especially noticeable in some of the photographs. Although the determination of the relative percentages of the different parts of the plant in these bales has been made on a laboratory scale, only our figures on several samples analyzed by different men check reasonably well. They show 23% lint, 27% seeds, 30% stem, and 20% cusps. In the field experiments during 1930 several different types of soil were used and as far as the records show they had little effect.

Mr. Dockery worked at Chapel Hill during the winter of 1930-31 on analytical work in connection with this investigation as well as carrying on his regular college work. To carry on the work during the 1931 season a grant of $1000.00 was made by the American Cotton Growers' Cooperative Association. During this year several different varieties of cotton were used and different methods of growing and cultivation were attempted. It was found that much better yields could be obtained by using rows 2 feet instead of 3 feet apart and allowing the plants to grow without thinning. Analyses of the growing plant during 1931 confirmed the results of the previous year. In 1932 the Federal Government forced the plowing under of our experimental plots. In 1933-4-5 no crops were planted.

These experiments indicated that a very promising yield of cellulose could be obtained from the cotton plant. However, when the results were published we were immediately confronted with the statement that even though it might be true that a good yield of cellulose could be obtained from the cotton plant, that cellulose was not suitable for the manufacture of paper or rayon. Therefore, the next problem that presented itself was an answer to the question, "Is the cellulose obtained from the whole cotton plant the same as that obtained from cotton linters and wood cellulose?" Since the equipment and material for pulping the whole plant and making rayon was not available at Chapel Hill, Dr. Cameron first attacked this problem by some of the usual methods for the identification of cellulose. Dr. J. P. Saunders, who had received his doctorate from the University of North Carolina in 1931 worked under Dr. Cameron in 1932 and 1933 with the assistance of Mr. E. G. Egan, an undergraduate. They purified the cellulose from various parts of the cotton plant. Then X-ray photographs were made of this cellulose and several derivatives of it as well as from the cellulose obtained from wood pulp. This method did not show any difference in the celluloses from the various sources. This result would indicate that the unit cell of cellulose from different sources was the same. The result, however, did not give satisfactorily the desired information as to the chain length and micellar structure of cellulose, so that another line of attack was attempted. During 1933-4 Dr. A. T. Clifford used the Spierer lens and attempted to determine whether there were any differences between the cellulose from various sources. This investigation also indicated that the cellulose from the whole cotton plant was identical with that from wood pulp and other sources. Thus two lines of investigation had failed to show any differences.

During 1931 and 1932 several sample cooks of the whole cotton plant had been made at the Champion Fiber Company's plant at Canton, N. C. These were done under the direction of Mr. Harold Murdock. The usual commercial acid sulfite process for wood chips was used. The results seemed to indicate that if the material were cooked long enough to disintegrate the woody part of the stems the lint portion was destroyed. If the cooking time were shortened, the woody stems were not sufficiently disintegrated.

This was the state of affairs when in September, 1934, I decided to work with Dr. Cameron on the whole cotton project because it would give me a fundamental knowledge of cellulose chemistry.

As Dr. Cameron outlined the investigation to me, there were two main problems—first, to attempt to extract the cottonseed oil from the whole plant and recover that oil in a merchantable condition, second, to make a high alpha cellulose pulp from the extracted material. There is no need here to go into details as to the many difficulties we met in accomplishing these objectives, but I feel it might be of interest to mention some of them and how they were overcome. In addition several new problems arose as the work progressed. One of the main difficulties which has been a source of trouble to the men who had previously worked on this problem and which had me stumped for over a year was a means of comminuting the whole cotton plant to give a uniform mixture. The solution was finally discovered by Mr. Dockery. He had the bright idea one fine spring morning of running the baled whole plant through a hammer mill such as is used to chop up and mix stock feed. Samples of the comminuted material are here and you can all see what a nice job has been done.

The first troublesome problem I encountered was that of decolorizing the oil after extraction. Dr. Cameron suggested that the decolorizing material (we used a charcoal material, norite) be put in the extractor with the solvent. This worked very nicely and gave a pale yellow oil. The melting point of this oil was somewhat higher than commercial cottonseed oil. After some further work, it was found that by cooling and centrifuging a solid wax could be separated and then the resulting oil was very similar to commercial cottonseed oil. The solvent used was benzene but I believe other solvents could be used with

similar results. With an apparatus which gives efficient solvent recovery the cost of this extraction will be more than paid for by the value of the oil recovered.

The extracted whole plant is free from all oils and waxes and in an excellent condition for uniform and rapid penetration of the pulping solution.

Our next problem was the pulping of the whole plant. In this work we were greatly handicapped by the lack of apparatus. However, this difficulty may well have been a blessing in disguise. My first idea was to pulp the whole plant by each of the commercial processes and any others which a search of the literature suggested and compare the resulting pulps after beating and bleaching. Since no apparatus in which pressure cooks could be made was available, it was impossible to carry out these experiments. The alkali process which corresponds almost exactly with the process of kier boiling with which you are all familiar, was as far as I could find the process which required the least pressure. I decided to try this process in the apparatus we had available. I had also found in searching the literature that several experimenters had obtained rather remarkable results with a nitric acid process which did not require any pressure. Another feature about this process which recommended it was the fact that the material on which it has been most successful was plant material similar to our raw material.

Mr. Murdock's results also influenced me. I reasoned that if using a pressure cook, the lint cotton was destroyed before the woody material was sufficiently disintegrated, might it not be possible that the use of pressure on the comminuted and extracted whole cotton would be not only unnecessary but actually harmful. Experimental results have borne out these suppositions and thus it appears that the lack of pressure equipment led to a series of experiments which open up an extremely promising prospect.

Pulps were made by two processes. First the extracted whole cotton plant was boiled for about eight hours with a weak solution of sodium hydroxide (about the strength of the usual kier boiling liquor). Second, the extracted whole cotton plant was treated at 85-90 degrees C. with a weak (about 2%) solution of nitric acid for three hours, washed and then treated with a 2% solution of sodium hydroxide for one hour. Both these pulps were then ground to a uniform suspension in ball mills. This process was intended to simulate the beating and screening which is given in the ordinary pulp mill. With the apparatus available, the exact reproduction of pulp mill practice was not possible.

These suspensions were then bleached. With my past experience as a boss bleacher in mind, I was interested in trying hydrogen peroxide. Well, it doesn't work, and later I found out what I think was the reason. When material such as wood pulp, which contains lignin, is bleached with chlorine, the lignin is chlorinated and in this form is soluble in a weak alkali and hence, can be washed out to give a good white. Of course where peroxide is used for bleaching, this action cannot take place. This seems to me to be a probable explanation of the opinion extensively and sometimes vigorously held by many bleachers that for the best white on pure white goods chlorine rather than peroxide should be used.

As regards bleaching with chlorine I found that the best results were obtained by using a double bleach. The first bleach liquor was on the acid side and contained 10% available chlorine on the weight of the pulp. After agitation for about ten minutes this solution was made neutral to phenolphthalein with sodium hydroxide and allowed to stand until a negative test for chlorine was obtained. This generally required about one half hour. The pulp was then washed and treated with an alkaline hypochlorite solution containing about 1% available chlorine figured on the weight of the pulp. This is the method of bleaching pulp suggested by Rue and Seonce and is extensively used for pulp bleaching. Although the idea of bleaching cotton in an acid solution will probably strike the cotton bleacher as rank heresy, it certainly gives a much better white on pulp, and may be worth investigation by some cotton bleachers.

The samples which I bleached by this method appeared to be very good white when in suspension but when they were filtered and compressed into a cake or a thin sheet they were a dirty gray rather than a white. Upon analysis it was found that the silica content ranged from 8% to 10%. This very likely accounts for the dirty gray color. This high silica content was of course a great disadvantage, nevertheless, the pulps obtained were analyzed for alpha, beta, and gamma cellulose. The analyses showed that neglecting the silica, the soda pulp contained about 90% alpha cellulose and the nitric acid pulp contained about 95% alpha cellulose.

Thus it appears that the whole cotton plant can be comminuted to a uniform mixture which is in excellent condition for extraction and pulping. From the comminuted material the cottonseed oil and the cotton wax can be extracted, purified and separated to give merchantable products and the extracted material pulped and bleached to give a cellulose pulp of high alpha cellulose content.

The high silica content of the above-mentioned pulp would, of course, make such pulp absolutely unsuitable for any of the ordinary uses of cellulose pulp. In fact, one time last year someone asked me, "What are you working on?" I replied, "Alpha-cellulose from the whole cotton plant." "How are you getting along?" "Boy, I've got the best asbestos shingles you ever saw." Then we both laughed, but really it is true. If you take these pulps from the whole plant containing 6% to 10% ash and suck the water out of them and dry them, you have a material which is remarkably hard, tough, and non-inflammable. I really think it may have possibilities, but not

along the main line of this project. We knew, of course, where most of the silica in the pulp had come from. It was, as Nick Dockery says, "Richmond County clay." The bales from which I had obtained my raw material had been standing on an open platform on the Dockery plantation for about four years. During that time they had of course collected a liberal amount of dust and dirt. Therefore, during the past fall and winter (1936-37) this problem of ash in our cotton plant has been attacked from two angles. First Mr. Dockery in harvesting the plant grown in connection with this project in 1936, secured the cooperation of the Deere Farm Machinery Company. They shipped a special harvesting machine to the Dockery plantation and cut and baled the plant immediately without allowing it to touch the ground. These bales were stored in dust-proof warehouses and analysis shows that the ash content is less than one half of one percent. Meantime, Mr. Davis Milne, working on his Doctor's degree under Dr. Cameron, and using the same material that I worked with, has succeeded in cutting the ash content down from about 10% to less than 1%. That, gentlemen, is the present status of the whole cotton project.

I think you will all admit that we have come a long way from the chance remark of Dr. Cameron in connection with the manufacture of soda ash back in 1928. I know Dr. Cameron and the group of men who have worked under him feel that the problem is far from solved, but we also feel that as one after another we have worked on this problem, its possibilities have broadened out, its ramifications have become more complex and far-reaching, and that the facts we have discovered tend in the main to indicate industrial possibilities for the project. Our main need now is funds to support one or more doctorate candidates so that they can put in full time on this project and to buy equipment and supplies so that our work can be repeated under conditions which will simulate plant practice near enough to give us definite cost figures and yields. Dr. Cameron estimates that a fund of $5000.00 to be expended over a term of two years would be adequate for this purpose. I am not begging anyone in the present audience to volunteer to contribute that sum to the advancement of science and the future prosperity of the Old North State, but if the shoe fits, I'll be glad to lend you a shoe horn to help put it on.

Like most research ideas, the present one has resulted in several side issues. First, consider the extraction of the oil. It is well known that by ordinary compression methods, about 10% of the oil is left in the compressed cake. Our tests indicated that our material, after extraction, contains less than 1% of the original oil content. Thus a much better oil recovery is possible.

Another point which has interested me, and which I would like to see investigated, is the possibility of separating the cotton fiber and the woody material and pulping them separately. When I first talked to Dr. Cameron, I mentioned this matter. "Now you're talking as a chemist, not as an engineer or a business man. Admittedly, you have in the cotton fiber a purer form of cellulose and it irks you as a chemist to contaminate this pure form of cellulose with the impure form which occurs in the woody portions. You would spend thousands of dollars of the company's money to get a much smaller yield of a slightly better product. That's typical of a chemist and that's the reason why you rarely find chemists as presidents of industrial concerns. Give me a chemist on my board of directors or as advisor, but for the man who makes the final decision about matters, give me a hard-headed business man. Remember when you separate your cotton plant into two parts you are doubling your labor cost, overhead, and equipment all along the line because now you have two types of raw material to treat whereas unseparated you have only one. Besides, how are you going to separate the lint from the rest of the plant?" At that time I couldn't see any possible means of doing this, so I just kept still. Since then, however, I have been able, working with the hammer mill comminuted plant, to get a reasonably good, cheap separation of the cotton fiber from the rest of the plant. Since I am still a chemist and not a hard-headed business man—well, I would still like to see something done with this idea.

Incidentally, I found later that the above suggestion was made by Mr. Murdock in his article on this project in the Paper Trade Journal in 1933. A similar feeling seems to be a common reaction among many men who are accustomed to deal with cotton as a fiber. For instance, the morning after the Columbus, Georgia, meeting of the Southeastern Section I was having breakfast with Harold Schroeder and Sidney Edelstein. Mr. Edelstein mentioned having read my paper in Industrial and Engineering Chemistry and we talked about it and the work Dr. Cameron's students had been doing for several minutes. Mr. Schroeder listened politely at first but I could see an expression of at first astonishment and gradually horror appear in his face. Finally he said, "Do you mean to say that you are seriously suggesting that we take the nice clean white long staple cotton fiber and deliberately destroy it by grinding it up with the rest of the plant?" I smiled. "Exactly that. Why not? Can you suggest any other annual plant that would be a better source of cellulose? And don't you realize that sooner or later modern industry is going to get sick and tired of waiting from seven to forty years for a tree to grow to give them wood pulp? Why, Mr. Schroeder, we are at the dawn of a new 'Age of Cellulose'." "But," Schroeder said, "That's—that's"— and then words failed him. Edelstein looked at me and said smiling, "Sacrilegious." "That's it—sacrilegious is the word," Mr. Schroeder added. And I will wager that the same idea is in the minds of many of the present audience. I realize that to a man who has spent many of the best years of his life "painting the lily" by mercerizing the cotton fiber and

knows what a beautiful piece of goods a highly mercerized cotton can be, the idea of deliberately destroying that beautiful fiber would be—well, sacrilegious, that's all. But after all, most new ideas come as a shock to us and I am really serious about that idea of the Age of Cellulose.

Let us consider its possibilities for a few minutes.

Most people when they think of cellulose think of paper and rayon. However, cellulose has many other uses. It is used as a filler in many plastics. Plastic wood, of which many of you have probably heard, has many uses. Beaver board, wallboard, artificial lumber and building material of all types can be made lighter, stronger, better non-conductors of heat, less inflammable, and more durable using a cellulose base or filler. For example, the so-called asbestos shingle I mentioned earlier.

Thus cellulose is or may well become a basic material in any industry that has to do with the preservation or promotion of knowledge such as books, newspapers, or motion pictures; in any industry that has to do with housing, such as building material, furniture, or plastics; and finally, with any industry that has to do with clothing or textiles.

Anyone who attempts to pose as a prophet lays himself open to a charge of making statements without a sufficient factual basis, so I am not going to make any rash prophecies.

Let's just day dream for a while. In rayon we have a fiber which from a commercial viewpoint is only about 25 years old, and yet in 1935, the last year for which statistics are given in the Rayon Handbook, rayon consumption in the U. S. was twice that of real silk, approximately equal to that of wool, and about one-fifteenth that of cotton. In 1936 the U. S. increased its production 30% and Japan 80% over the 1935 figures. In the course of a recent conversation with Mr. Heyward of Swift and Co.'s Wool Department he stated that some southern mills were successfully spinning wool-rayon mixtures on cotton machinery. Heretofore, as far as piece goods were concerned, it has generally been a case of mixing cotton and rayon. However, I believe that this new type of goods is due for another sensational development. Think what it will mean as far as wool suiting is concerned—a much cheaper and more lustrous better-looking piece of goods which, to be sure, will probably not wear quite as well as an all wool garment. However, that is not such an all-important factor. How many of my present audience wears a suit of clothes until there is a hole in the seat of the pants? Most of us get tired of it and throw it away before that time comes.

Economists tell us that any new product goes through a stage of phenomenal growth until it establishes itself in its rightful field and then levels off with production fairly stable. It is evident from the above statistics that rayon is still in the growth stage.

However, to me the most promising and fascinating day dream of all is that of improving the strength and quality of rayon itself. In this field I believe we have only scratched the surface of the possibilities. Silk is our strongest and most beautiful fiber. Man is following the same general principles in making rayon that the silk worm does in making silk, i.e., he is causing a thick viscous solution to coagulate. The silk worm has succeeded in orientating the chains of unit cells during coagulation to give a strong durable fiber. The rayon manufacturer has not as yet been successful in doing this, although stretch spinning is a step in the right direction, but some day he will, and when he does he will have a fiber about 50% stronger than silk.

I base this statement on two known facts—first, that cellulose of which rayon is made, is chemically a more inert substance than the proteins of which silk is composed; second, in the January issue of Rayon there appeared a table of the strength of various fibers in which silk is given as 4 grams per denier and ramie (a cellulose fiber) as 6.3 grams per denier. Some day we will make rayon as strong or stronger than ramie. When this time comes, it will be possible to spin a strong, hollow or porous rayon which will have a lightness, warmth and covering power exceeding that of the natural fibers.

Thus it would appear that the demand for cellulose is due to increase by leaps and bounds. With the ever increasing speeding up of industrial processes which is such an outstanding characteristic of our modern life, the need of an annual plant as a source of cellulose is irrefutable. We who have had the honor and pleasure of working under Dr. Cameron upon the whole cotton project have in some cases, gradually, I will admit, become convinced that the cotton plant is the inevitable answer to that demand.

Believe me, gentlemen, we are still loyal adherents of King Cotton. In spite of the feeling which Mr. Schroeder expressed that the whole idea is sacrilegious, we intend no lese majesty. We merely hope to broaden and extend his kingdom till at some future time like the vision the witches showed Macbeth of Banquo's descendants, King Cotton will "Two fold ball and treble sceptres carry."

DISCUSSION

Chairman Smith: For the benefit of those who have just come in, Dr. Heuser, chairman of the Cellulose Division of the American Chemical Society, has consented to speak to us on this subject, and he may also say something on cellulose in general.

I introduce Dr. Heuser.

Dr. Heuser: Gentlemen: I am afraid that your chairman promised too much. I am afraid it is too late to talk to you on cellulose in general, but I would like to express my opinion, if you want, on the subject that has been presented to us. Before doing so, I would like to ask Dr. Macormac a few questions.

Dr. Macormac said that the yield of cellulose which he

gets when converting the whole cotton plant into cellulose is 55% and that the cellulose in wood amounts to only 40 to 45%. I would like to correct this. The cellulose content of spruce wood is 55-58%, but the processes which we apply for making wood pulp are not so ideal as to produce the whole yield. It is therefore correct to figure on a yield of 42 to 44% cellulose; part of it is hydrolyzed when applying the sulfite process and part is dissolved when we apply the soda or sulfate process.

Then you spoke of the bleaching of the cotton plant pulp, and if I understood you correctly you said that this is done by applying an acid hypochlorite solution and that about 10% chlorine on the cellulose is consumed. I think that is rather high and very likely has some damaging effects on the fiber. Besides I believe a better method would be to apply in a first stage gaseous chlorine, which acts very rapidly, but with less damage on the lignifying material. The products of reaction are soluble in water and still better in diluted alkali and may thus be easily washed out.

After that follows a second stage of bleaching which may be carried out with hypochlorite solution.

This method should also be more economical than using hypochlorite in the first stage.

Coming to the main point, I am afraid I am on the side of those having the "chemical" view.

When we look at the cotton plant, it is against our "chemical" feeling to take this beautiful white cellulose material and contaminate it with the lignified material of the stems, etc. In using wood, we cannot do anything else because lignin and cellulose and other non-cellulose materials are all interwoven in one and the same organ of the tree. They cannot be separated unless by chemical action. In other words, we have to take the raw material as it is. But in the cotton plant we are so fortunate as to have the various substances, namely the lignified material in the stems, leaves, etc., and the pure cotton in the bolls separated in the various organs from the beginning. It would then seem logical to isolate from the plant that cellulosic material which can be isolated easily and in the most pure form, namely the almost pure cellulose as contained in the bolls and give the cellulose which is incrusted with lignin, etc., material only second consideration. This way of looking at the problem was already considered by Mr. Macormac and possibly regarded as the better one. But the utilization of the lignified material of the plant would come up only if there were a real shortage of cellulose.

We should not forget that there is in Canada and the United States an abundance of wood which in spite of all fears will last for generations and likely forever if the present serious endeavors of reforesting are continued and extended on a systematical basis. Thus, it will always be difficult for cellulose from other sources to compete with wood pulp.

As regards the pure cellulose from the bolls, it may be admitted that serious difficulties in harvesting may not exist since the same organization could be used which serves the purpose of harvesting of the textile cotton. However, I am afraid that it would be in a position to compete with wood pulp only if it were possible to grow a grade which is not in question for textiles, that is which the textile industry could not make use of. But here again, we should not forget that the product in order to compete with wood pulp would have to be cheaper than cotton linters, and this would be the same if the whole cotton plant were converted into cellulose.

I am sorry that in view of the energy invested in solving the problem, I only add to the criticism which you, Mr. Macormac, and others connected with the problem, already have experienced, and that I have said little to encourage you which, otherwise, I would like to do.

I would appreciate it very much if you believe me that I do not criticize because I am connected with the wood pulp industry, that is, as a competitor. I am looking at this problem only as a cellulose chemist and technician and I feel I should warn against too much optimism. Still, I may be wrong, and only further development can give us the answer. (Applause).

Did you ever consider cuprammonium viscosity when producing the desired white in bleaching? I understand that the cuprammonium viscosity is one of the control methods applied to cotton and wood pulp during purification to determine whether they are adaptable to rayon manufacture. Sometimes a good white may be obtained by bleaching, but the cellulose has been degraded to the extent where it is unfit for rayon manufacture, therefore, cuprammonium viscosity must be considered before it is said that the cellulose is fit for artificial silk manufacture.

Mr. Macormac: It would undoubtedly be a very good method for us to use to check up on whether we are getting a chain length similar to the chain length of cellulose now used in making rayon. When it comes to a question of rayon pulp, the final decision is to make rayon out of it. I think it is generally admitted that the cuprammonium viscosity is a measure of the chain length. It that right, Dr. Heuser?

Dr. Heuser: No doubt that is right. A good means of finding out whether cellulose has suffered during its past history is to determine the viscosity in cuprammonium solution, since we assume that the viscosity is directly related to the chain length of the cellulose molecule, in other words to the damage or non-damage which has been done to the cellulose during the process of isolation, and refining. More damage means that the chain has become shorter, indicated by lower viscosity and vice versa.

Mr. Sixt: I have an idea that where high cuprammonium viscosities are desired, as for acetylation, this purified cellulose would not meet the specifications.

Dr. Heuser: The alpha cellulose content runs, as Dr.

Macormac told us, between 88 and 97 per cent according to the treatment given. Acetyl cellulose requires an alpha cellulose content of 97 to 98 per cent. But I would expect that the severe bleaching as Dr. Macormac described it, would give too low a viscosity. As far as I remember, Mr. Milne made some experiments to produce cellulose acetate from the cotton plant pulps which came out satisfactorily if the alpha of the pulp was high enough.

Mr. Morton: I would like to say a word in opposition to my brother Dr. Macormac, and in defense of Dr. Cameron, from the business man's side. I cannot see but what the value in this process, if value is to be derived, would be from a production standpoint to give a cellulose production at low cost. If you attempt to separate your lint cotton then you run right back into the question of lint cotton with the value of 14 or 15 cents per pound, which is about the average for the last 15 years, in competition with purified cellulose being used by rayon manufacturers from wood pulp for 5 cents, and cotton linters 6 to 7 cents. It seems to me, to separate your fiber from the cellulose stems is going to run into the business side and run up against a pretty stiff proposition. If, however, using the whole plant, and extracting cellulose from the plant gathered and treated in the mill at a cost that could be arrived at that would be in competition with those other forms of commonly used cellulose by the rayon trade, then there would be some possibility of it, but I believe Dr. Cameron is right in saying that you should look at the business side as well as the chemistry side.

Dr. Macormac: We have prepared some exhibits here, and if any of you care to come up and look at them, we have a selection of various products, including the several stages in the manufacture of this cotton material, starting from the boll. After the meeting is over, I will be glad to have any one interested come up and look them over, because you cannot see them from your seats.

Mr. Gaede: I would like to ask a question regarding the yield. You said the yield was approximately 55 per cent of cellulose from the whole plant. Have you run any tests to determine how much of that yield was cotton, what percentage of cellulose came from the cotton fiber, and what from the stalk?

Dr. Macormac: No. This analysis giving 55 per cent is not a figure that I would want to depend on. They were the figures that Mr. Dockery made when we first started this investigation and he analyzed the various parts of the plant and got a result that gave him 55 per cent cellulose. On the basis of that, we went ahead. I do not want to imply that we could get anything like a 55 per cent yield of cellulose pulp. We have not, and we have not been able to do this on anything more than a laboratory scale. We have not any real yield figures.

Mr. Gaede: Your pictures show a good deal of cotton in the boll. Don't you think it would be interesting to determine how much of that cellulose was coming from the cotton, from the standpoint of economy of things?

Mr. Macormac: I have figures that I think about 23 per cent of the whole plant is lint, the cotton fiber and cotton lint. In our treatment that would probably give us all cellulose, in other words there is no stage in the treatment where we give such a severe treatment that it would destroy the cotton fiber. Let us say that 55 per cent cellulose is about 20 per cent from the cotton fiber.

Mr. Gaede: That would be one-third to one-half of your cellulose?

Dr. Macormac: Yes, derived directly from the cotton fiber and the rest from the stem.

Dr. Heuser: To what percentage of the plant amounts the stem? You said 20 to 25 per cent of the plant is lint.

Dr. Macormac: Taking the whole plant, 23 per cent lint, 27 per cent seed after the so-called cotton lintage is taken off, 30 per cent stem and 20 per cent pulp. That is the outside, what the ordinary person speaks of as the boll.

Dr. Heuser: 27 per cent seed. How much cellulose does that give?

Dr. Macormac: None.

Dr. Heuser: And you have 30 per cent stem?

Dr. Macormac: Yes.

Dr. Heuser: Which is lignified?

Dr. Macormac: Yes. I would say you would get a yield of cellulose there one-third less than you would from wood; that is 46 per cent. We figured the lint at 23 per cent, and 30 per cent of stems, and we got about 20 per cent of cusp.

Mr. Milne: Your cusps and stems together make up about 50 per cent of the whole plant. In the cellulose we recover from both of them, it is about the same, and then you have got about 20 per cent lint from which to recover practically 100 per cent, and that gives you between 50 and 60 per cent total cellulose, and in treating it the way I do get from 40 to 50 per cent yield, although I have not been careful about that. I have been more interested in getting rid of the ash.

CALENDAR OF COMING EVENTS

Joint Summer Outing, South Central, Piedmont and South Eastern Sections, Lookout Mountain Hotel, Chattanooga, Tenn., August 6th and 7th.

Fall Meeting, Piedmont Section, Carolina Hotel, Pinehurst, N. C., November 6, 1937.

Annual Meeting and Convention, December 3 and 4, Bellevue-Stratford Hotel, Philadelphia, Pa.

Synthetic Resins

and Their Application as Textile Finishes*

D. H. POWERS†

BEFORE I start this extemporaneous talk, I want to make it perfectly clear that I am neither a resin expert nor an authority on resins.

I had the opportunity of attending a symposium on resins not long ago, and as a result of that symposium I am convinced that there is little concrete information known about resins and that they are working by trial and error. In a number of years I hope there will be a little more information on the subject.

Tonight, I want to present some of the information that I have picked up here and there, occasionally from books, occasionally from the laboratory, and occasionally from the textile mill.

Before going any further, I want to say that whenever I come in contact with synthetic resins I am impressed with the fact that they are a powerful tool for the development and modification of textile fibers and fabrics. Their application offers possibilities of producing entirely new effects which had not been dreamed of before their discovery.

In attempting to get a little clearer picture of synthetic resins, I have listed a series of questions which I will take up this evening with the hope of answering them and giving you opinions I have gained from inquiring here and there. The first question is:

Why Are Synthetic Resins of Interest?

One reason for our interest in resins is based on the fact that they offer us new materials which go through a soluble or molten condition and ultimately become an insoluble tough film, sheet or mass. In other words, if it weren't for the fact that synthetic resins can be handled in a transient or intermediate, soluble state, they would be of little value.

The synthetic resins owe their value to this ability to polymerize or to condense. Since they are initially soluble in organic solvents or in water, they can be shaped, molded or coated and then converted in a few seconds or a few hours, by drying or heating, into a completely insoluble form.

One of the largest applications for synthetic resins is in the paint and varnish industry. We all know that the painter applies a varnish or paint with a brush. The resin in the paint is in a soluble, flexible form that flows. On exposure to air or, in the case of baking enamels, on exposure to heat, it is converted to a completely insoluble, wash-fast, and substantially permanent form.

Turning to the next question:

Why Are Synthetic Resins of Interest Now?

Why are they coming to the forefront at the present time?

The real reason is because they are *new*. The synthetic resin industry has developed within the lifetime of all of us, and I am glad to say that this country has contributed a large share to the work that has been done. A great deal of work has been done abroad, but a great deal has also been done in this country.

From a historical viewpoint, Hyatt's work in 1868, when he first made celluloid as an imitation of an ivory billiard ball, was one of the earliest experiments with a synthetic resin. More recently, the development work of Leo Baekeland on the phenol formaldehyde condensation in 1908 is considered the start of this industry.

A little later, the development by Kurt Albert of modified phenol formaldehyde resins widened the range of usefulness of these resins. Still later workers at General Electric developed the alkyd resins. Today we have ten or twelve major classes of resins which are commercially available.

Although synthetic resins are a recent development, I heard it recently said that they have been developed to a point in the paint, varnish and coating fields, where you can name the type of resin needed and it can be supplied. This was not possible five years ago. Probably twenty years from now we will smile when we recall that in 1937 we thought that there was a suitable resin for every type of requirement.

There is no question but that there is a wide range of types available, and in the future we will probably see more improvement along the line of reducing costs, simplifying applications, and extending the range of usefulness.

The next question is:

What Are the Important Types of Resins?

Tracing them historically, the *ester gums* were the first to be used in large commercial quantities. They are the glycerides of rosin. Rosin is condensed with glycerine or alcohol to form an ester. This type of resin is still used in large quantities in the cheaper varnishes and coatings.

Then come the *coumarin* or *indene* resins, which are derived from the naphtha hydrocarbons. They give a tough, very resistant, very low cost resin. These resins have high resistance to water, alkali and acid, and are finding demand where resistant varnishes of this type are required.

Next come the *phenol formaldehyde* resins, a type which

*Presented at Meeting, New York Section, April 23, 1937.
†Rohm & Haas Co., Inc.

were first developed by Baekeland by reacting phenol and formaldehyde in the presence of a catalyst. Today we have a wide variety of the phenol formaldehyde resins. They range in color from a pale yellow to a dark brown. The phenol formaldehyde resins are normally used either as unmodified phenol formaldehyde resins from phenol or cresol condensed with formaldehyde in varying concentrations, with varying catalysts, or as the so-called modified phenol formaldehyde resins, which may be phenol and formaldehyde condensed in the presence of rosin or ester gum, or a combination of rosin and glycerine. The combination of the rosin or ester gum with the phenol formaldehyde makes it possible to produce oil-soluble resins which are particularly valuable for paints and varnishes.

The fourth class are the *alkyds*, a more recent development. The most important condensations in the alkyd series are the glycerin-phthalic anhydride condensations.

Broadly speaking, the alkyds are formed when a dibasic acid condenses with a dibasic or polybasic alcohol. These resins as a class are somewhat more expensive than the phenol formaldehyde type, but they have the advantage that they can be polymerized or co-polymerized in the presence of a wide range of drying oils. They are being adopted where durable, tough, light-colored films are required, particularly in the automotive industry for coating our present day cars.

Some of the newer resins which are just beginning to develop and show real promise include the *vinyl resins*, which are obtained by condensing acetylene with acetic acid in the presence of a catalyst. Most of the vinyl resins are either polymerized vinyl acetate or vinyl chloride, or co-polymerized mixtures.

The *acrylates* are a type of resin which we have recently heard a great deal about. They have the tremendous advantage of absolute clarity and light stability, and while they are rather expensive as yet, their cost is being rapidly reduced. They show real promise for impregnating and coating fabrics and for producing glazed effects.

The *urea formaldehyde* resins are being adopted more widely, particularly for light colored molded articles—condensing urea and formaldehyde in the presence of varying catalysts to get a clear water-white resin. They have a decided advantage over the phenol type in that the urea formaldehyde resins give white and pastel shades and form a glass-like solid.

Then three other resins which show considerable promise at the present time, but which have not developed in tonnage compared with the earlier ones, are the *polystyrenes*—where styrene is polymerized, to give a water-clear resin. The *chlorinated diphenyls*, or the arochlors, and the *petroleum hydrocarbons*, which are a new type of resin, are unusually resistant and unusually tough and show considerable promise for certain types of resistant coatings.

The next question is:

What is a Resin?

I have been trying to find a good definition for a "resin" but if any of you know what it is when you leave, you will be qualified to write a book on resins. I shall try to lead you through some of the confusion that it has led me into, and at least give you a simple definition.

"A resin is a solid solution of organic compounds." (Laughter) Now that you know what a resin is you can start to write your book. (Laughter) Glass, of course, is a solid solution of inorganic compounds. Glass is a solid which consists of a number of similar compounds all mixed together to form a so-called "solid solution."

Another definition of a resin, which doesn't help us very much either, is that it is "a molecular aggregate of indefinite structure". (Laughter)

Still another definition of a resin is that it is "a polymerized or condensed substance of plastic nature".

Whenever they try to define a resin they try to make a definition to which there are no exceptions and there is apparently no such thing as an all inclusive definition.

Generally speaking, "a resin is a resinous material". (Laughter)

To revive the old story about the man who named his daughter "Ann": when they asked why he named her "Ann" he said, "Well, she is such an indefinite article"—I think that can best be applied to resins. They should be called "Ann". (Laughter)

The next question is:

What Are the Properties of Resins That Make Them Valuable?

They should be film forming. They should be tough or impart toughness and strength to other products. They should be low in cost. They should be light in color. They should be quickly convertible from a soluble to an insoluble form.

Why Should we be Interested in Putting Resins on Textiles?

The application of resins to textiles offers limitless possibilities. They can be used to modify fabrics and keep them as fabrics, and to my mind it is this effect that makes them really interesting—the fact that you can treat a textile with twenty to thirty per cent of a hard resin and end up with a fabric—which to the average woman in the store is unchanged in appearance.

The application of resins to fabrics gives modified properties, depending on where you put the resin and what concentration you use. By varying the concentration, varying where you put the resin, and varying the type of resin used, it has been possible in the short space of time that the problem has been studied, to produce two or three hundred different and distinct types of effects on varying types of fabrics.

The next question is:

Is it Important How we Apply the Resin?

The same resin, in the same physical form, in the same degree of aggregation, in the same type of solid solution, will give entirely different effects on the same fabric, depending on whether it is *on* the fiber, *between* the fibers, or *in* the fiber.

It is only within the last few years that we have begun to have some idea as to how to put the resin into those three different places.

We are all acquainted with the so-called resin coated fabrics, such as oilcloths, bridge table covers, artificial leather—where the fabric is coated with a film of a resin, plasticized nitrocellulose, or with a drying oil. This type of application ruins your fabric; as in the case of artificial leather, it is not a fabric we obtain, it is a resinous film with a cloth background. The cloth has lost its identity, it has lost its character as a fabric and has become merely a resin sheet with a cloth backing.

Until relatively recently, all of these coated effects were produced from a solvent solution, using solvent-soluble resins. More recently it has been possible to develop water dispersed resins or water soluble resins, and apply them to the surface of the fabric, removing the water to leave the resin in a semi-soluble or dispersed form which can be converted into a completely insoluble form.

What Difference Does it Make Whether we Put the Resin Around or Between the Fibers?

There is no point in predicting or claiming at this time that resins will replace softeners, starches or gums as finishing agents. After all, vat colors have not replaced direct colors or developed colors. On the other hand, fabrics finished with resins even in extremely low concentrations have certain advantages and permanency which may be superior to a starch or an oil on these particular fabrics.

Resins show tremendous promise as sizing materials. Within the past two months we have been sizing some yarns at grey mills with resin. Mr. Zametkin will have to change his paper* the next time he gives it, if he gets hold of these fabrics. (Laughter) But, of course, the idea in resin sizing is to put on a size and not have it come out later on, and whether there is a question of surface tension or Gibbs' Law won't play an important role.

Where resins are applied to the warp yarn without impairing the character of that yarn—and I say that "without impairing the character of the yarn" advisedly,—it opens up the possibility of using shorter staple cotton, it opens up the possibility of producing cotton with the luster of rayon, it opens up the possibility of obtaining grey goods that do not have the shrinkage or the working loss of our existing fabrics, and it opens up the possibility of building into our yarn in the grey state characteristics and effects which we now work to obtain in the finish.

*"Some Aspects of the Scouring of Rayon," to be published in this Journal.

What Properties do Resins Contribute to Fabrics?

When resins are applied to the surface of the fibers, they may *increase their strength*. It is surprising that some fabrics show large increase in strength with a small amount of surface resin. It acts as a cementing medium between the fibers increasing their resistance to rupture.

If the resin is a hard, brittle resin and is set between the fibers as a glassy film, the fabric instead of being stronger, may be weaker, because the fibers break off short, instead of stretching as they do in a rope. If, on the other hand, the resins have a certain elasticity and a certain flexibility, they impart a surprising increase in strength, even when used in low concentrations.

Resins can be used to give an actual *increase in weight*. Other resins are striking in their ability to give an *apparent bulkiness*, without an actual weight increase. That is due to the fact that the fibers are given a little more rigidity and fullness and they don't slip over each other as readily, so that when you pick up a cloth it feels as if it were twice as thick. A fabric may seem twice as heavy with a weight increase of only one-half of one per cent.

Surface resin application opens the possibility of *surface luster*, of *surface glaze*, and of *waterproofing*. Up to the present time, wax or the aluminum soaps give much better waterproofing than even fairly high concentrations of resin. But it is a question of getting the resins in the right place, getting a thin enough film, and coating them around the fibers in the proper way.

Shrinkage and slippage are factors of which we have been hearing quite a bit lately. There again, a small amount of surface resin tends to set the fibers without impairing its characteristics as a fabric. The fabric still feels and looks like an ordinary fabric, but it is an improved product in that it shrinks less and slips less. There is an appreciable amount of resin setting the threads, without preventing it from being a fabric.

Why Should the Resin be Put Into the Fiber?

Tootal Broadhurst Lee Co. of Manchester, England deserve the credit for really developing a process and making us realize that if the resin is put *in* the fiber, it gives the fiber new and unique properties. An interesting thing is that in the Tootal process they use a resin which is hard and brittle.

This fabric (indicating), which is a piece of cotton percale, has the resin on the outside, and has the characteristics of a urea formaldehyde resin. It is hard, brittle and clear. You can see the pattern of the cloth, but it is as hard as glass. Yet when you get this same resin *into* the fiber, the fabric is soft and has a fullness and a body that would not be expected. Resin experts had previously felt that a hard, brittle resin would never be suitable for textiles, because they said "Your fabric will be like a board". Actually, the fabric has a softness, an added drape, an

added fullness, and an added resilience which the original fabric did not have.

The method of the application of the resin is an extremely important point. The same resin used on the same fabric, in one mill, where they get most of the resin into the fiber and very little resin on the fiber, will not remotely resemble the same fabric when they get only half the resin *in* and half the resin *on* the fiber.

While the treatment of fabrics to get the resin *in* the fiber has been centered on in the T.B.L. process, this type of development is only in its infancy. It offers the possibility of taking an existing fabric and changing its weight to make it a ten to twenty per cent heavier article for fall wear, and using the same grey goods and putting in one or two per cent for spring wear,—thus we have a procedure for building up or changing the character of your fabric by incorporating a resin in it which will change its character to suit the changing market.

In other words, we can imagine the time when a finishing plant or mill will get one construction of grey goods the whole year round, and by varying the concentration and method of resin application they will get their complete range of fabrics.

Let me turn now to another side of this subject.

What is Wrong With Resin Application?

Perhaps one of the most important problems is the *cost*. Again and again, we find that a resin is not tried because of the increase in the cost of the fabric. This fabric here (illustrating) has its sale price increased thirty per cent by using a low cost resin. This fabric here has a sale price that is about twenty per cent higher than the price of the untreated fabric—and there is a large demand for it. This fabric here has a margin over all of its competitors, with a large sale, and with additional advantage and profit, because it contains a relatively low concentration of resin. When the resin is properly applied it more than pays for itself.

On the other hand, there is no doubt that in a great many cases cost is the factor preventing the adoption of the resin. Yet it is encouraging to see what the mill or the finisher can accomplish when he sets out to see what he can produce at the lowest cost. I saw some white goods a month ago that were finished with a resin at a cost of three-hundredths of a cent a yard. The resin finish was there and the effect was striking. The improvement with the permanent resin effect easily justified the cost.

I saw another fabric, finished at a resin cost of three cents a yard; but it will be sold at a thirty cents per yard premium.

Another problem, is the *difficulty of application*, and there is no question but that there is difficulty. Resins are a new tool and they require new methods for application. They offer a new means of treating fabrics, but like any new procedure, they offer difficulties. We are making every effort possible to eliminate the problems of textile mill application, but we still have a long way to go.

The perfect resin would be one where the finisher could take his goods, run them through a water solution of resin, dry, and ship out. That condition is approaching, and when you consider the fact that these resin caps were produced by heating a synthetic resin in a mould under two thousand pounds pressure at a temperature of three hundred fifty to four hundred degrees to get this cap; when you consider that as a starting point, and when you realize that today resins have been fixed and made wash-fast on a fiber at temperatures below two hundred twenty degrees; when you consider that the curing conditions have been reduced from a long time at a high temperature to a few minutes at room temperature, or a few seconds at the boil,—you must realize that the application of synthetic resins has been greatly simplified.

Originally, the resins could only be handled in organic solvents, but today a range of alkyds, a range of urea formaldehydes, a range of phenol formaldehydes, and a range of acrylic ester resins, are available in aqueous solution. It is clear that most of the difficulties of application can be overcome.

There are cases where cotton goods are run in continuous resin application all day long, with the fabrics coming out at the end with completely fixed resin, completely wash-fast—in a single, continuous operation. There have been other cases where plant trials for weeks have failed to get the resin fast. These, of course, are extreme cases.

The next question is:

What Fibers Can be Treated?

All fibers. Just what effect you get depends on your resin, it depends on your fabric construction, it depends on the type of application used. To date they have not been successful in getting certain resins *into fibers* such as silk and wool—the animal fibers. It is not difficult to get resins *on* and *around* these fibers and to get coatings. To get it *into* silk or wool fiber is very much more difficult, possibly because these fibers do not swell as much. It may be that some day substantive resins will be available at a low cost, resins which have a true affinity for the animal fibers, and when that times comes we will be able to take the resin and sprinkle it into the dye bath and have it adsorbed, the way a truly substantive dyestuff is taken up.

Acetate rayon and silk have been successfully treated, and wool has been impregnated to produce attractive improved permanent finishes. So has cotton, and, of course, spun rayon. When we think of spun rayon, we frequently feel that it is ideally suited for resin application. Spun rayon shows great improvement and a great many different unpredictable changes are obtained by using varying concentrations of a resin. On nearly all spun rayon

fabrics some type of resin is necessary to give character and life.

A customer claims that an all spun-rayon fabric is too raggy. A woman's dress dosen't drape well. It doesn't hold its shape. It bulges. It pulls out of fit. It sags. The seams pull out. It hasn't character. By varying the method of application, and by varying the resin content from one-half to twenty per cent it is possible to get hundreds of different effects and build a spun rayon into a variety of attractive, striking and unique fabrics.

Finally, What is the Limit of Their Application?

I guess I don't need to give you my opinion on that question. The limit of their application is the limit of our imagination and our willingness to persevere and work out each application of each resin to the particular fabric.

Today, when it comes to the question of selecting which resin gives the best result, it is not a problem of what finish or what effect can be produced with a resin, but what modification of your fabric or your yarn you want. I am glad to say that in the last few years there have been rapid developments along these lines.

Here is a fabric. Everything is the matter with it. We can correct it with resin.

Here is a yarn that has certain inherent faults. Maybe we can't change the construction. We can built it up with resin instead.

Let me close by saying that the future of resins and their use in finishing is in your hands. It would seem that they have a bright future, and I can only hope that I can interest you sufficiently to investigate them and see just where they are particularly suited and how they should be applied.

Let me add that every initial application that I have ever seen of a new resin was unsuccessful. I have never seen a case where a really new and distinct problem gave a first trial which was successful. In fact, this solid brittle sheet (indicating) was a first attempt to produce a non-crush fabric. (Laughter.) Frankly, we had a right to quit, temporarily at least, because that is not exactly an article you would sell for a woman's dress fabric. But the fact remains that today that same resin on that same fabric produces a material which sells in markets never dreamed of for the untreated fabric.

DISCUSSION

Chairman Baxter: The Tootal Broadhurst Lee Co., the English firm of which Dr. Powers spoke, worked for fourteen years on this problem with an idea of producing, on cottons principally, I think, a fabric which would have some of the characteristics of wool. Considering the fact that they worked fourteen years on it before anything was developed, I think the progress that has been made in the last three years has been remarkable. This is about the period of time that the process has been out, and about the period of time since process was brought to this country.

I am sure there are a good many questions that you men would like to ask Dr. Powers. The floor is now open for questions.

Mr. Johann: Doctor, assuming that all the swatches you showed us tonight were samples from production runs, was it necessary to operate under the T.B.L. patents for them?

Dr. Powers: There are only a few fabrics here that are processed under the T.B.L. patent.

The T.B.L. process, for which they worked so long and ably, is the process of treating a fabric with a synthetic resin, to penetrate the fiber, and give it increased resilience and crush resistance; in other words, broadly speaking, it is the production of an anti-crease fabric by means of a resin application. Their process discloses the phenol formaldehydes and the urea formaldehydes, and the method of getting the resins into the fiber to produce a more resilient fabric.

As I mentioned, this fabric here (indicating) is an anti-crease fabric. This velvet is anti-creased by the resin process.

These other fabrics are all resin effects, some of them with the resin applied on the surface, some of them with the resin applied between the fibers. Some of them are stiffer than others, but they are not anti-crease in any sense of the word.

Mr. Uzunoff: Speaking of resilience, can you tell us how permanent that effect produced on the rayon fabric is?

Dr. Powers: It depends on the fabric and on the fiber. The interesting thing, or perhaps the surprising thing, is this: that the resins themselves are insoluble, yet in certain cases the finish is not as permanent as you would expect it to be.

There again it depends on what you mean by "permanent." When they say "I want a permanent finish," they frequently mean they want a permanent stiffness. If you treat a fabric with a resin—a surface resin—to give it stiffness, and if you take that fabric and mechanically break it down, all your resin stays in the goods but some of your stiffness has gone. In the sense of permanent stiffness, it isn't permanent, as a sheet of the resin itself would break down, if you hadn't a thick enough film.

On the dress fabrics the resin will last as long, if not longer than the colors, and will last as long as a great many fabrics, particularly where they are given mild washings.

Mr. Uzunoff: Could you enlighten us further about the crush-proof resin?

Dr. Powers: That is the urea formaldehyde resin, which is sensitive to strong alkali. In a cast sheet, alkali has little effect on the resin. But in a fabric the resin has only a fair alkali resistance. The better the resin cure, the better the penetration and the better the wash fastness.

We find that if you take a crush resistant fabric and wash it twenty-five times you will lose about half of the resin. If you start with an ample resin content, at the end of twenty-five washings you will still have a satisfactory crush resistance. If, on the other hand, you are considering a dress fabric that isn't given a severe soap and soda ash washing, it will last even longer.

Mr. Uzunoff: How does that affect velvets?

Dr. Powers: Of course, there is no problem of wash fastness, as the velvets are not washed. The problem on velvets—and there are those here who can answer this question better than I can—is a problem of application. A velvet has a soft pile and you must keep it soft. You must handle it so that the fabric after treatment is still soft, and resilient. Since you are treating it with a resin which is hard and brittle, you must get every bit of that resin out from between the fibers.

When you get the resin into the fiber, you get an added resilience and you get a crush resistance which is far superior to the fabric in the untreated condition. With good penetration, and all of the resin removed from between the fibers, you get a soft resilient fabric.

Mr. Uzunoff: What method would you advise to get better penetration on velvets using a silk background?

Dr. Powers: The following factors are important: first, your fiber must be adsorbent; your ground must be scoured; your fabric is dyed and after dyeing, it must be thoroughly rinsed; it must be cleaned from oils, and gums, and extraneous material which will resist the penetration of the aqueous resin solution, which is as thin as water. Then it must be wet out in that solution and squeezed, squeezed not so much to get it in—because if it is adsorbent you will get penetration—but to remove the excess from between threads and get the resin out. It must be squeezed until the last traces of surface resin are out. Then it must be dried and cured. Of course, part of your crush resistance in a pile fabric is due to the improvement of the back, and isn't entirely due to the improvement of the resilience of the pile. It is partly due to building up back, and as you improve both, you improve your crush resistance.

All flat goods are washed, and washed severely, after a resin treatment. The problem of washing a pile fabric is a much more difficult one, and it is interesting to note that when you wash a pile fabric it is much more difficult to get as good a crush resistance. The actual resin loss may be very slight, possibly one or two per cent. But its effect on the fabric is marked. The problem is to build up your fabric before washing, so that you can allow for a come-down and end up with a soft, resilient fabric.

Mr. Uzunoff: Is the strength of the fabric treated with synthetic resin impaired?

Dr. Powers: If you can get all of the resin into the fiber your strength is equal to or better than in the untreated fabric. If you get all of the resin on the outside of the fabric, it becomes so brittle you can crack it with your fingers. But we know from repeated experiments: the less your surface resin, the better your strength.

Mr. Uzunoff: Speaking of impregnation of the fiber, why doesn't the resin react or produce the same effect on different fabrics, that is, fabrics of different construction?

Dr. Powers: Well, that is a good one. I don't know. (Laughter.)

In that connection, let me ask you a question. I think it is only fair. Tell me why a broadcloth has never been successfully resin-impregnated or anti-creased, whereas sheeting and drills can be satisfactorily treated?

Mr. Uzunoff: That was why I asked you that question. (Laughter.)

Dr. Powers: Of course, the resin pick-up is a function of twist. It is a function of adsorbency.

We know today that we can do fabrics that two years ago we couldn't have touched, because we have improved the technique of penetration.

Mr. Blackwood: Dr. Powers, have you ever seen any fabrics that have anti-crease properties that still have most of the resin on the surface, and very little inside the fabric?

Dr. Powers: Yes. At the Bureau of Standards they did some work on evaluating crush resistance. They found, first of all, that it was very difficult to evaluate, but they found one thing that was consistent, and that was that the anti-crease fiber and the anti-crease fabric was always firmer and stiffer than the untreated.

There is no question but that fabrics with a surface coating which gives them a little more stiffness, without making them brittle, have an increased crush resistance, because it takes more energy to crush them. On the other hand, it is our own feeling that in none of those cases do you get an actual increase in fiber resilience. This surface effect does not increase your resilience, but it increases the surface rigidity, and that will give an apparent improvement over an untreated fabric.

The thing I am a little afraid of is that there will be a tendency to substitute for a real increase in resilience an increase in stiffness in fabrics, for after all, we don't want increase in stiffness; we want increase in resilience.

Mr. Blackwood: Does plasticizing help?

Dr. Powers: That does help. The only way to make the fiber resilient, however, is to start with wool or silk, or to build into the fiber certain properties.

Dr. Barber: Doctor, can your resin be applied to the yarn before the goods are dyed and finished? In other words, can it become a substitute for warp sizing?

Dr. Powers: I have some goods here that were warp sized with resin.

Dr. Barber: Will it interfere, in the dyeing of those goods, with the absorption of the dyestuff?

Dr. Powers: It affects it, but the effect can be adjusted for.

No one answer to a question of this sort is true as applied to all resins. Some resins will absolutely prevent dyeing, because they coat the fiber. Other resins because they penetrate the fiber would not cut down the dyeing appreciably. With any application of that sort, it must be uniform or you will get variations in your dyeing.

This fabric here (indicating) with almost twenty per cent resin wets out better than the untreated fabric.

Dr. Barber: I think I know the answer to your question on the broadcloth and the drill.

Broadcloth is a taffeta weave—smooth. The drill is a twill weave. As the weaving advances, the resin gets into the depressions.

Dr. Powers: A rayon taffeta can be treated with resin.

Dr. Barber: Yes, because that is a smooth cloth.

Dr. Powers: It seems to be more than just simply a question of pressure.

Mr. Ganzell: Dr. Powers, how can the operator prove that the resin is deposited on the inside of a fabric?

Dr. Powers: There has been a lot of work done on that problem. For example, here is one resin which is in true solution. You can dialyze it like an inorganic salt which is in true solution. Here is a higher polymer, a less soluble form of the same resin. It forms a clear but colloidal solution. You can use these resins, in the same concentration, on the same fabric. The one in colloidal solution will leave the fabric stiff and wiry. The one in true solution will leave the fabric soft. However, we have not been able to prove how far into the fiber the resin goes.

Mr. Ganzell: Are there no chemical tests on the finished fabric?

Dr. Powers: They have tried microscopic cross-section but so far as I know this method has not been successful.

The difficulty is that the resin is so finely dispersed. It certainly goes below the fiber, but whether it goes into the center of the micelle is a question, and staining methods have not been satisfactory.

Mr. Ganzell: But the Tootal process states they are truly inside, so they must have some method of proving it.

Mr. Miller: Cannot your resin be colored in this form in which it appears?

Dr. Powers: Yes.

Mr. Miller: Couldn't that in turn be put on the fiber and that in turn be examined under the microscope?

Dr. Powers: When your resin is in true solution you cannot satisfactorily color it. Let me ask you this question: can you color salt when the salt is dissolved in water?

Mr. Miller: No. Perhaps that resin would carry certain colors, and then when it combines itself with the fiber it would still carry the color with it.

Dr. Powers: The resin does hold some of the dyestuff to a certain extent and may improve its fastness.

Mr. Miller: To a sufficient extent to permit you to examine it under the microscope?

Dr. Powers: Anyone who wants to tackle that problem has my sympathy and encouragement. The resin is glass-like and it has no particular affinity for dyestuffs. So far as I know, no method of staining has been successful in proving where the resin is situated.

Mr. De Grost: I should like to thank Dr. Powers for posting us on the fact that in years to come we will be able to slash different fibers with synthetic resins. Probably by that time we will be able to cope with some of these problems, which we cannot cope with now, on sizing fibers with gelatin.

Mr. Cook: Referring to the type of resin which is said to give a permanent luster, are such resins in actual use, and to what extent are they permanent, from the luster standpoint?

Dr. Powers: There (indicating) is a resin that is clear, hard and glass-like. You can wash it, you can dry clean it.

There is a great deal of work going on at the present time to develop the most economical method for giving luster with resins. I have some fabrics that show that. But the real problem is to put all the resin on the surface, to get the maximum luster.

Mr. Cook: Has it been worked out satisfactorily from the mill standpoint?

Dr. Powers: I would rather have a mill man answer that. We think results are promising. The mill man's problem is production, and it must fit into a production schedule.

Another factor is cost: at a high cost, you can do it today. The problem is to do it cheaply, and I think that is on the way.

Mr. Cook: How permanent is the luster? Could you express it from the standpoint of the number of washings it will stand, for instance?

Dr. Powers: If you get a thick enough, tough enough film, it will last as long as your fabric lasts. On the other hand, if you get a wafer-thin film and put the coated fabric in a washing machine—which you never do to a high luster fabric—it will not stand the abrasive action.

You have to keep in mind that the resin will only stand a reasonable amount of mechanical breaking or beating. If you put on a heavy film like that, it will stand everything; you can walk on it. If you put on a very thin, paper film, it will stand much less.

Mr. Cook: In other words, you get what you pay for.

Dr. Powers: Yes.

Mr. Trendley: Dr. Powers, does a fiber that has been treated with a resinous compound lose its affinity for aluminum oxide, such as is contained in waterproofers? In other words, can you waterproof a material that has been treated with a resin?

Dr. Powers: The answer to that is, "Yes, and no."

Low concentrations of resin, well penetrated, will not materially affect it. On the other hand if you have a high concentration of surface resin, it will definitely retard your penetration; it will definitely retard your dyeing.

Mr. Trendley: Does the resin have an affinity for the aluminum oxides?

Dr. Powers: Not so far as I know. Resins are rather inert. With an alkyd type resin, which may contain some free fatty acid, it is possible that some of the free fatty acid groups will combine.

Mr. Trendley: Then you suggest not waterproofing materials when treated with resins, resins which adhere to the surface, rather than being impregnated in the fabric?

Dr. Powers: You can tell me, better than I can tell you, that waterproofing is purely a surface effect. Otherwise, the low concentrations you use couldn't possibly do it. We hope some day to develop a resin to give as good a surface effect as waterproofing agents do.

Mr. Dougan: What type of resin will give you the best resistance to abrasion?

Dr. Powers: The toughest. The resin that is the most flexible. On the other hand, any resin that is brittle, if it makes your fiber brittle, will cut down your abrasion resistance. A resin which is soft, such as this type of resin (indicating)—seems to help more than many others, because it tends to hold your fibers together and make them unite. A thin film of that will stand abrasion.

Mr. Klein: Does the presence of the dye in the fiber interfere with penetration?

Dr. Powers: Surprisingly little. There is no question that some colors cut down resin adsorption. There doesn't seem to be any way of predicting what colors will cut down resin adsorption the most. Some dark sulfur dyed fabrics seem to take up considerably less resin than undyed or light shades. But even on black fabrics, a large amount of resin is taken up. There is no definite correlation between the amount of color and the amount of resin taken up.

Mr. Klein: Is there any correlation between the type of dyestuff and the amount of resin taken up?

Dr. Powers: I don't know enough about that to speak definitely but I would say that so far as our experience has gone the sulfurs probably cut down resin adsorption the most, then the vats, and directs and developed colors retard the least. But that is just a general indication.

Mr. Klein: You don't know whether there is any difference within the groups themselves?

Dr. Powers: Oh, no. (Laughter.)

Dr. Johann: Does the pH of the cloth have any definite bearing on the amount of resin you are able to get in the material, speaking of cotton?

Dr. Powers: It has an effect on the curing of the resin. All resins give certain particular properties when cured at a certain pH, and if your cloth affects that pH one way or the other, it will affect the curing or fixation, or type of resin you get in the fiber. But it doesn't seem to affect the penetration much. It doesn't affect the resin the way it might the dyestuff.

Mr. Ganzell: Is the size of the molecule of importance on impregnating? In other words, is it essential that one impregnate with dimethylol urea, or with the unpolymerized molecule of the urea formaldehyde condensate?

Dr. Powers: I don't know. I heard a paper on what urea formaldehyde was when it polymerized, and I know less about it now than I did before I heard the paper.

Apparently a low polymer is better. Here is an example: these three samples are all urea formaldehyde resins. This first one we know has a lower molecular weight than the second, and the third has a higher molecular weight than the other two. We are sure that this last one does not penetrate the micelle at all. I have here a set of spun rayon suiting fabrics, treated with five per cent solutions of each of these resins and finished—and you can pick them out. The first one is soft, the second firm, and the third is hard.

Mr. Ganzell: Depending upon the molecule?

Dr. Powers: Yes. Generally, the lower the polymer, the better the penetration. The ratio of the urea to formaldehyde has a definite effect on the result. Our experience has indicated that the ratio of the urea to formaldehyde has a very definite effect on the finish; it can be altered to make it harder or softer.

Mr. Schmidt: What effect do the dry cleaning solvents have on these resin-treated materials?

Dr. Powers: As a rule, not any effect. It depends on the resin, but usually the dry cleaning solvents have no effect at all. If we used a solvent soluble resin and didn't polymerize it, it would be affected. But as a rule the resins are very resistant to dry cleaning.

Mr. Schmidt: You talked at the beginning of your lecture about resins from petroleum. Are they made intentionally?

Dr. Powers: Yes, that was a very nice and a very difficult piece of research. These resins are a close approach to natural rubber, in that they are tough, resistant, elastic materials.

Mr. Schmidt: You are not talking about the resins that are made from the refining of gasoline, then, when you say petroleum resins?

Dr. Powers: You have me there. (Laughter.)

Chairman Baxter: Dr. Powers' paper has certainly brought forth a lot of interesting discussion and indicates just how interested you all are in this subject. I am sure that if we were to have another meeting on this same subject a few years from now there would still be a lot of discussion and a lot of questions. I feel exactly as Dr. Powers expressed himself as feeling: that the developments in the use of resin compounds for finishing are in their infancy.

AMERICAN
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ARBITRARINESS

PRESIDENTIAL arbitrariness, booted and spurred, is on the rampage in this nation. Mounted on the third horse of the Presidential figurative three horse governmental team, it is attempting to ride ruthlessly and roughshod over the principal guard rails that have been erected to protect this nation from just such a possibility.

The attack on the Supreme Court is only one case in point, although it is probably the one of major importance.

Every reader will recall the original excuses given for the attack on the Supreme Court. He also knows how these were exploded by Chief Justice Hughes and others. He will also recall the Presidential figure of speech describing the three-horse team in which the President insisted that two of the horses, Congress and the President, were pulling together while one horse, the Supreme Court, was thwarting "the legislative will."

A review of some of the facts regarding the actual working of this metaphorical three-horse team is instructive. Over approximately a century and a half the Supreme Court has, to use the President's expression, "vetoed" acts of Congress 75 times. In contrast to this record, President Roosevelt, in slightly more than four years, and up to the end of April, 1937, has vetoed 221 acts of Congress. This is more than all the vetoes of Taft, Wilson, Harding, Hoover and Coolidge and is practically three times the number of Supreme Court "vetoes" over a period of approximately 150 years. Had the Supreme Court thwarted the will of Congress at a rate equal to that of President Roosevelt, its number of vetoes would have been not 75 but 8,250. And had the President equalled the record of the Supreme Court he would have vetoed not 221 acts in four years but only 2.

Despite the fact that this sort of calculation is open to various statistical objections, the essential facts in the situation are sufficiently clear to demonstrate just how completely misleading was the President's homely metaphor.

But the vitally important aspect of this attack on the Supreme Court lies beyond the inaccuracy of this Presidential metaphor and the explosion of the President's supposed "facts" regarding the inability of the Court to keep abreast of its work. It lies in the fact that the essence of the issue is simply the desire of the President to have his way. Presidential arbitrariness is a fact that cannot be avoided nor successfully denied. The multitude of devices which are employed as excuses, or as justifications, or as pacifiers of the gullible cannot cloak this central and essential fact in this picture.

Perhaps the most important aspect in the whole situation is whether or not the majority of the American people can be aroused before it is too late, to an understanding of what all these things may mean to this nation if this unprecedented and un-American Presidential arbitrariness is not curbed before it leads to even more serious consequences than are already observable in the stresses, strains, and struggles now agitating our foolishly-divided people.

If the American people are to receive the necessary protection from this unbridled Presidential arbitrariness, such protection must be found in Congress, particularly in the United States Senate. The people of this country should turn their most earnest attention to that body, and do all in their power to see to it that its members adhere firmly to the principles and structure of Constitutional government, in spirit as well as in letter.—*Walter E. Spahr.*

BOOK REVIEW

"Man in the Chemical World," by A. Cressy Morrison. Pages 292, graphically illustrated. Published 1937 by Chas. Scribner's Sons. Price $3.00.

This volume is published as a fitting accompliment of the Chemical Industries Tercentenary. 1635-1935.

It summarizes the vital part played in American life by chemical industry in the translation of scientific abstractions into the materials essential to civilization and progress. Many leading industrialists reviewed the manuscript before publication thus assuring accuracy, and authoritativeness. In a sense never before realized "Man in a Chemical World" is an autobiography of an industry.

It is intended to be educational, from the cultural as well as the utilitarian point of view, and it will serve to impress the man in the street with the fact that the chemical industries of the United States render a service which touches practically every activity in which he engages.

It was not intended that this book should be a profound contribution to the profound literature of theoretical or applied chemistry, but rather a record of the accomplishments of man in the role of creator. For the student who is considering a career in science and especially for those who have the heavy responsibility of vocational guidance, this book should be a real help. Its reading will certainly bring one into a clearer understanding of his relationship to material things, and the vital part chemistry has played in the development of his health, food supply, clothing, and comforts of modern living.

TRADE NOTES — NEW PRODUCTS

• LACQUER PRINTED DESIGNS

Successive dry cleanings and pressings have no effect upon textiles with lacquer printed designs, according to a report made by Roxalin Flexible Lacquer Co., Inc., of Elizabeth, N. J., of a survey of the users of their Flex-Tex printing lacquers. Silks, taffetas, rayons, acetates and cotton printed in all colors by stencilling, engraved roller and silk screen methods, are claimed to retain their original softness, without loss of "feel" or texture. It is stated that their durability has also stimulated the use of Flex-Tex for decorating shower curtains and transparent umbrellas.

• DRYING RESEARCH

An outline of the purposes, program, organization, administration and financing of the cooperative study of textile drying under the auspices of U. S. Institute for Textile Research at the National Bureau of Standards has been published in a 16-page booklet. It explains how the progress reports and other services of the study may be obtained, and also contains a description of the Institute's cooperative research plan. Copies may be obtained by addressing the Secretary of the Institute at 65 Franklin St., Boston, Mass.

• NEOPRENE

Neoprene, an engineering material with rubber-like properties, yet one which is said to resist the deteriorating effects of oil, heat, sunlight, chemicals and oxidation, is described in detail in a new handbook published by Rubber Chemicals Division, E. I. du Pont de Nemours & Company. This presentation considers separately the effects of various types of oils, acids, sunlight, heat and other forces which result in rapid deterioration of rubber products and indicates the type of service which may be expected with a similar part of neoprene.

Specific applications of neoprene, including hose, electrical cable, molded parts, extruded material, sheet goods and gaskets are also described, with data on reasons for the use of neoprene in these applications. Of special interest is a summary of the method of making neoprene and its chemical composition.

• JOINS RIGGS & LOMBARD

R. C. Collins has recently been appointed sales representative for Riggs & Lombard, Lowell, Mass., in New Jersey, Pennsylvania, Delaware, Maryland, West Virginia and Virginia.

• SAILS FOR EUROPE

Ralph Wechsler, treasurer of the National Oil Products Company of Harrison, N. J., sailed Wednesday, June 16, on the S.S. Manhattan for a three months' business trip to Europe. Mr. Wechsler will visit England, France, Switzerland, Egypt and Palestine.

• NOPCO COPPING OIL NO. 7

For the conditioning of fancy rayon and acetate yarns, the National Oil Products Co. of Harrison, N. J., is offering NOPCO Copping Oil No. 7. It is said to emulsify instantly in cool or warm water, to be highly stable, to reduce static electricity and to be resistant to oxidation and rancidity. It is further said to produce excellent softening and lubricating effects on both acetate and viscose yarns. Technical data bulletin on request.

• NEW SOAPING MACHINE

The machine illustrated is used for soaping woolens and worsteds before fulling. It has been thoroughly tested under normal operating conditions in a number of well-known mills over a period of two years.

The advantages claimed for this machine are an exceptionally uniform soaping and an important saving in soap. Savings of this type have in some instances been as much as 27 per cent.

The machine is manufactured by Riggs & Lombard, Inc., of Lowell, Mass.

• SYNTHETIC ORGANIC CHEMICALS

The 1937 edition of "Synthetic Organic Chemicals," published by Carbide & Carbon Chemicals Corporation, has just been announced. This 78-page booklet is an interesting and useful industrial reference manual on the specifications, properties, and uses of over 80 aliphatic organic chemicals. The data is authoritative and up-to-date. Much of the information on aliphatic alcohols, amines, aldehydes, esters, chlorhydrocarbons, glycols, ketones, and other chemical families can be obtained from no other source. A copy can be secured by writing to Carbide & Carbon Chemicals Corporation, Dept. L, 30 East 42nd Street, New York, N. Y.

• LAURELTEX NO. 340

A new transfer remover—Laureltex No. 340—for use on silk hosiery for redyeing has been placed on the market by the Laurel Soap Manufacturing Company, Inc., Tioga, Thompson and Almond Streets, Philadelphia. The manufacturers claim this new product will remove trade marks on silk hosiery quickly and economically, before stripping and redyeing.

• DRYSALTERS OUTING

The fifty-second Annual Outing of the Drysalters Club of New England was held on June 25th at the Andover Country Club in Andover, Mass. There were over 325 members and guests present. The majority present played golf, although many enjoyed horse-shoes, tennis and baseball. The day was ideal for an outing and helped to make it the success that it was. A banquet was held in the evening after which the following officers were installed: Alvah H. Pierce, President (General Dyestuff Corp.); Arthur H. Sampson, Vice-President (Calco Chemical Co.) Frank W. Benvie, Secretary-Treasurer (General Dyestuff Corp.); Joseph A. Bryant, Director (Arnold-Hoffman Co.); James R. Emmett, Director (Special Products Co.); James C. Hayes, Director (National Aniline & Chemical Co.); Michael J. Lane, Director (Geigy Company, Inc.).

The following committee members were appointed: *Membership Committee*—James Barrington, Chairman (Union Color & Chemical Co.); W. M. Dewing (General Dyestuff Corp.); W. J. Stevenson (United Indigo and Chemical Co.); *Dining Committee*—Walter L. James, Chairman (Geigy Company, Inc.); Warren E. Lincoln (Nyanza Color & Chemical Co.); Henry Arnold (National Aniline & Chemical Co.); *Entertainment Committee*—M. P. Graham, Chairman (Calco Chemical Co.); Joseph E. Travers (United Aniline); Woodward Allen (Solvay Sales Corp.); *Auditing Committee*—Charles Herrick, Chairman (Union Color & Chemical Co.); W. P. Heinz (E. I. duPont deNemours & Co., Inc.).

• GEIGY RELEASE

Geigy Company, Inc., 89 Barclay St., New York, announces release of the following circular:

Eriochrome Blue BL — a new afterchrome color for fast wool dyeing, said to possess the good general fastness properties of this class of colors and also outstanding fastness to light. It is stated that on account of its good leveling properties it is suitable for dyeing wool in all

stages of manufacture and for vigoureux printing, not only alone, for the production of rich deep navy blues, but also as a blue component for all types of shades. It is especially recommended by the manufacturers as a topping color on wool previously dyed with indigo and in consequence of its fastness to light properties its use is said to improve the fastness of such navy cloths to conditions of wear, weather and friction. Circular 943.

• GENERAL RELEASES

General Dyestuff Corp., 435 Hudson Street, New York, announces release of the following sample card and circulars:

Dyeings Fast to Sea Water on Wool Yarn—a new sample card illustrating a number of shades produced with suitable acid dyestuffs, as well as Palatine Fast colors and chrome colors, according to the chromate and chrome topped method. Colors are selected which meet the requirements of the bathing suit and sweater trades as to fastness to water, salt water and washing. Sample Card I.G.1167.

Palatine Fast Red LBN—a new red of the Palatine Fast series which is said to be of very good fastness to light, water, salt water, washing and light fulling. It is especially recommended by the manufacturers for dyeing of carpet, knitting and hosiery yarn, men's wear and better class of ladies' dress goods. It should also be of interest to hat dyers. It is said to have good affinity to pure and tin-weighted silk. Circular I.G.1288.

Raynise A—a new auxiliary of I.G. manufacture for sizing acetate warp beams in the open width. It is said to have the advantage over sizes produced on a linseed-oil base in that it is easily removed with hot water. Circular I.G.1231.

• JOINS ARKANSAS COMPANY

The Arkansas Company, Inc., announces that Dr. E. W. K. Schwarz has joined their staff as Technical Director. His duties will include that of adviser to the company sales force.

Dr. Schwarz is well known to the industry as technical editor of *Rayon Textile Monthly* and co-author with H. R. Mauersberger of the *Rayon and Synthetic Yarn Handbook*.

His technical experience started as chemist with the Badische Aniline und Soda Fabrik, which post he left in 1923 to come to the United States. Here he jointed the pioneer dyestuff firm of Kuttroff & Pickhardt, and later connected with the General Dyestuff Corporation.

Dr. Schwarz took his Ph.D. degree at the University of Erlangen and was a pupil of Otto Fischer. He also studied under Prof. Wilhelm Ostwald, founder of the famous color theory. He followed his studies with scientific investigations at the

E. W. K. SCHWARZ

Textile Research Institute of Muenchen-Gladbach.

Dr. Schwarz is a member of the following societies: American Chemical Society, American Association of Textile Chemists and Colorists, American Association of Textile Technologists, American Institute of Textile Research, New York Academy of Science and Verein der Freunde und Foerderer der Faerbereischule Krefeld.

Dr. Schwarz brings with him a wide knowledge of the wet processing of textile fibers, based on practical experience. His service will be available to all textile mills who may have problems to solve.

• TOURING EUROPE

E. C. T. Bick, president of Bick & Co., and Mrs. Bick are at present on a five weeks' tour of European countries. They will make their headquarters at Cologne. Mr. Bick is combining both business and pleasure on this trip.

• CIBA RELEASES

Ciba Company, Inc., Greenwich and Morton Sts., New York, representing the Society of Chemical Industry in Basle, have recently issued the following publications illustrating their newest products:

Direct and Acid Dyes on Half-wool—This card includes the newer Chlorantine Fast and Direct dyes which were not included in Card No. 776a. This card especially features the most practical neutral dyeing acid dyestuffs for use in half-wool dyeing. The Chlorantine Fast and Direct dyes are shown dyed at different temperatures, while the Acid and Cloth Fast colors are dyed at a boil from a salt bath. Sample Card No. 776b.

Padded Shades Made with Ciba and Cibanone Vat Dyes, Micro Powders, Paste and Micro Pastes—This card shows 56 shades on cotton poplin. The padding of unreduced vat dyes on a mangle is preferable in the case of light and medium shades and has a particular advantage for light fabrics, because in ordinary dyeing the unevenly twisted threads are likely to produce an uneven appearance. Of late it has also become the custom to pad the heavier and difficultly penetrable goods, which offer difficulties on the jigger. The Ciba and Cibanone dyestuffs in Micro Powder, Paste or Micro Paste are recommended by the manufacturers with an addition of Cellex. The development takes place on a jigger in a blank vat. Sample Card No. 1337.

Cibacete Colors—This card illustrates type colors, mode shades and discharge effects on dischargeable Cibacete grounds on acetate fabrics, also mixed fiber goods of cotton, rayon and acetate, as well as 3 and 4 fiber combinations. The fastness properties of the Cibacete dyestuffs are shown in a new form of tabulation. Sample Card No. 1350.

Neolan Dyes, Type Dyeings on Wool Pieces—This card illustrates the latest Neolan types as well as the older well known types. The newer brands are said to be notable for easy levelling and very good fastness to light. The type dyeings are shown in three shades and the most important fastness properties are tabulated according to the new classifications. Sample Card No. 1370.

Direct Dyestuffs on Rayon—This card illustrates 132 types of direct and after-treated dyeings. Attention is called to the fact that the Rigan Colors offer a particular advantage in the dyeing of viscose of unequal affinity; there is also a notation of the Direct dyestuffs especially suited for this purpose. Sample Card No. 1380.

Neolan Dyes, Fashion Shades on Wool Yarn—This card shows 142 dyeings of the Neolan types and fashion shades. The fashion shades, which are said to resist a light milling, are collected together. In dyeing fast shades on wool yarn, namely, for knitting and carpet yarns, the Neolan colors are said to be finding increased use. It is claimed that Neolans have an advantage over Chrome dyestuffs in their simpler method of application, a more desirable handle of the goods and the possibility of producing more brilliant shades. It is stated that carpet yarns dyed with Neolans show particular resistance to a number of influences; they show particular resistance also to brushing with ammonia water, which is so necessary in the case of upholstery goods, for railway coaches, etc. According to the manufacturer most of the Neolans are resistant to the Oriental wash for rugs which uses caustic soda and hypochlorites. Sample Card No. 1385.

Albatex PO in Vat Dyeing—This card illustrates the action of Albatex PO as an assistant in promoting penetration in package dyeing and in the dyeing of pastel shades on piece goods. The illustrations

show that Albatex PO is a valuable auxiliary in vat dyeing. Sample Card No. 1397.

Cibacete Dyestuffs, Printed on Acetate Fabrics—This card illustrates the application of Cibacete colors in powder form for direct printing. The powder brands are said to be easily dispersible in warm water and to mix with the thickening without any residue. Sample Card No. 1398.

Dyeings on Worsted Yarns, Fast to Sea Water — This shows a number of new shades which are fast to sea water, according to the German Fastness Commission tests. A table furnishes details concerning the determination of this fastness. The dyestuffs shown are from good to very good light fastness. Sample Card No. 1400.

Neolan Dyestuffs, Fashion Shades on Wool Goods—This card shows a large number of lively popular tones on women's wear, which are said to be fast to washing, light and perspiration. It is said that acid dyes, which are generally used for such materials, often fail to reach the necessary fastness to washing. Neolans, it is claimed, make it possible to produce dyeings that are very fast to light as well as fast to washing and perspiration. The Neolans are said to be especially suited for the production of lively fashion shades on account of their easy levelling and simple dyeing process. Sample Card No. 1410.

Dyeings on Woolstra Yarn (Wool and Rayon Cut Staple)—This contains 144 shades on Woolstra yarn, consisting of 70 per cent wool and 30 per cent delustered viscose cut staple. According to the requirements of fastness, the dyeings have been made with Half-wool, Polytex, Half-wool Fast and Polytex Fast dyes, Chlorantine Fast colors alone or in combination with Cloth Fast or Neolan colors, Rosanthrenes and Diazo Fast colors, shaded with Acid dyes and later developed. This card contains also Woolstra dyeings made by the half-wool-chrome process and finally dyeings made by the two-bath process, dyeing first with Diazo colors and cross dyeing in a fresh bath with Cloth Fast, Neolan or Chrome Fast Dyes. Sample Card No. 1412.

Ciba and Cibanone Colors — The card shows 90 types in two shades on cotton yarn. The products fast to light, washing, water, wear and weather are designated by the mark P, while those which do not belong to this group are said to be of general good fastness and suitable for such goods as do not require one or more of the main fastness properties. The fastness properties are arranged according to the new system of rating. Sample Card No. 1417.

Dyeings on Silk Hosiery—51 fashionable shades on degummed material consisting of natural silk and mercerized cotton. The dyeings have been made in the soap bath, since this procedure has become most popular. The shades are said to show a good uniformity of shade. Sample Card No. 1419.

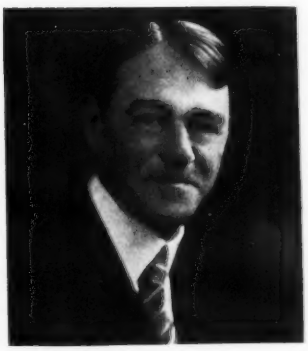
Artificial Silk Black CA—this dyestuff is shown on cotton yarn, viscose thread, cotton fabric, loose cotton, viscose satin-tricot and crepe, also on cut staple and various mixed fibers as well as in printing. The dyeings are said to be of good fastness to washing and water, but may be greatly improved by an after-treatment with formaldehyde and acetic acid. Acetate fibers are only reserved when present in small effects, but there is a two-bath process which will permit the reserving of larger effects. The dischargeability of this dye on cotton and rayon is said to be especially noted. The production of cheap, dischargeable Nigger Brown and Navy Blues by the use of Artificial Silk Black CA, giving pure whites, is shown by two samples. Sample Card No. 1445.

Chlorantine Fast Reds 5GLL, 6BLL; Chlorantine Fast Scarlet BNLL; Chlorantine Fast Greens BLL, CLL, 5GLL—These dyestuffs are shown on mercerized cotton, viscose yarns, cotton piece goods, pure-dye silk, cotton-viscose piece goods, mercerized cotton repp and delustered viscose and acetate fabric. Chlorantine Fast Red 6BLL and Scarlet BNLL as well as the greens are said to reserve acetate pure white. It is stated that all the dyestuffs shown are of very good fastness to light. Sample Card No. 1450.

● JOINS ROYCE

The Royce Chemical Company has announced that Mr. P. J. Wood, formerly Vice-President of the Oriental Silk Printing Co., Paterson, N. J., has joined its staff. Mr. Wood will devote all his time and effort to the New England territory, both in marketing and service to the Textile Industry in that section.

Mr. Wood brings to this work, an unusually good training and background of experience. He is a graduate of Leeds Boys Modern School and the University of Leeds. His apprenticeship was served with the Bradford Dyers Association. For three years he was Chief Chemist of the American Silk Dyeing and Finishing Co., Hawthorne, N. J., and following this he was Superintendent for two years, of the Peerless Finishing Co., Nyack, N. Y. For a period of twenty years Mr. Wood was Vice-President of the Oriental Silk Printing Company, Paterson, N. J., in full charge of all its operations. During the past few years Mr. Wood planned, installed and set into operation, two new dye houses and finishing plants—one for the Mt. Hope Finishing Co., North



P. J. WOOD

Dighton, Mass., and the other for Stonecutter Mills Co., Spindale, N. C.

Mr. Wood is a charter member of the American Association of Textile Chemists and Colorists. He was president of this organization for two years, from 1930-1932, and was the first Chairman of the New York Section. He is a Fellow of the American Institute of Chemists, and a Director of the U. S. Textile Institute for Research. He is also a life member of the Chemists Club of New York City, and a member of the Hamilton Club, Paterson, N. J. In addition he has the distinction of being a member of the Colorists Club of Providence and New York City. Mr. Wood brings to his new responsibility, an unusually fine background of practical experience which will be outstanding in its value to those in the trade.

● 1937 FALL HOSIERY COLORS

The regular edition of the 1937 Fall Hosiery Card, showing nine shades, has just been issued by the Textile Color Card Association to its members, it was announced recently. As previously stated when the confidential advance card was released, the collection comprises five new tones, Burnt Sugar, Blushglo, Rio, Incatan and Andes and four repeated shades, Carib, Cafe Clair, Avenue and Smoketone.

An entirely new format has been used in this card for presenting the colors. They are now shown in loose double swatches of hosiery material, which permits of handling them more conveniently for matching purposes and at the same time gives a better idea of the true value of the colors than was possible with the former tab arrangement. As usual, the card is issued in cooperation with the National Association of Hosiery Manufacturers.

● SYNTHETIC PRODUCTS

Dr. James K. Hunt of E. I. du Pont de Nemours & Company, Inc., addressed the annual convention of the American Insti-

tute of Decorators at the Waldorf-Astoria Hotel in New York City on Thursday, June 17th, on the subject "New Discoveries in Synthetic Products and Their Relation to Decorating."

Dr. Hunt referred to the present status of the diversified chemical manufacturing industry and discussed the various synthetic products which this industry has to offer the field of interior decoration in the way of new fabrics, finishes, plastics and other materials. Dr. Hunt emphasized the fact that recent developments in the field of synthetic chemistry have made it possible for the decorator to achieve new and beautiful effects, combined with serviceability, which hitherto were impossible with natural products.

The speaker called attention to recent important developments in the rayon field and pointed out that many decorators are now finding new beauties in color and texture in the variety of fabrics made from rayon yarn. In this connection Dr. Hunt spoke also of the fast vat dyes which now find wide application on both textiles and paper.

Pyroxylin coated fabrics which are widely used as upholstery materials, in the making of screens, desk pads, waste paper baskets and other decorative accessories are another class of synthetic materials to which he called attention. In this connection, reference was made to the new waterproof, washable window shades which have found wide application in the home, hotel and office building.

Dr. Hunt also referred to water-repellent treatments for fabrics, which modern chemistry has made possible, pointing out that this treatment does not change the appearance of the fabric. One of the newest developments of the chemical laboratory, he said, is a mildew-proofing treatment which prevents the growth of destructive fungi on fabrics that are exposed to dampness.

• MATHIESON CHANGES

Several changes of interest to the industry have recently been announced by the Mathieson Alkali Works, whose main offices are at 60 East 42nd Street, New York. Chief among these is the appointment of Robert M. Mannheim as New England district manager with headquarters in the Hospital Trust Building, Providence, R. I. Mr. Mannheim has been a member of the Mathieson organization for the past six years and has covered the northern New Jersey territory until his recent appointment to the New England managership.

ROBERT M. MANNHEIM

JAMES R. HARRINGTON

James R. Harrington, who has been covering the New York metropolitan area for Mathieson, will take over Mr. Mannheim's old territory in northern New Jersey, while Donald G. Ross will replace Mr. Harrington in the New York area. Mr. Harrington is a graduate of Washington University, St. Louis, Mo., and a former member of the Titanium Division of National Lead Company, while Mr. Ross received his training at Princeton University and has been until recently a member of Mathieson's New York office staff.

DONALD G. ROSS

• WORLD DYE OUTPUT

World production and consumption of coal-tar dyes continued to expand during 1936 with most leading producers making gains both in domestic and foreign sales, according to C. C. Concannon, Chief of the Commerce Department's Chemical Division.

While reliable or official data relative to the dye output of certain countries are lacking—notably for Germany, Russia and France—it appears that Russia and the United States made the greatest production gains, he stated.

Basing estimates upon the best data obtainable at this time it appears that world production was in the neighborhood of 243,000 metric tons last year, the highest annual figure ever recorded, and compares with 221,500 tons in 1935, and 215,500 tons in 1934, it was stated.

Production and consumption gains recorded last year as well as in 1935 were due largely to acceleration of textile and other consuming industries throughout the world, especially the greatly increased manufacture of military and other uniforms during the latter year, reports from various parts of the world indicate.

Germany, the United States, Soviet Russia, Great Britain, Japan, Italy, France, Switzerland, and Poland continued the world's leading producers, in the order named, during 1936. While there still exists a considerable trade in certain types of dyes between these countries, all of them appear to have attained a high degree of self-sufficiency, according to Mr. Concannon.

All the countries mentioned, except Germany and Switzerland, have so far concentrated largely upon producing for the domestic market, but some have developed a substantial export trade, particularly with China and British India and with other countries which are still either partially or wholly dependent upon foreign sources for their dye requirements. Germany, according to estimates, exports from 40 to 50 per cent of its production, and it is fairly well established that Switzerland exports as much as 95 per cent of the total, according to the Commerce Department.

While Germany is known to be the world's leading producer of synthetic dyes, official statistics regarding its output are not made available. Estimates placed the output of that country at approximately 76,000 metric tons in 1934 compared with 66,000 tons in the preceding year and 75,000 metric tons during 1929. Last year as well as in 1935 qualified observers believe that the 1934 total was attained if not surpassed by German producers, it was stated.

A substantial part of the German output is exported, the bulk going to Oriental markets, chiefly China and India, though German dyes are well established in practically every market of the world—approximately half of the dyes imported into the United States originate in that country, statistics show. In 1936 Germany's exports of dyes were recorded at 33,743 metric tons, against 33,933 during the preceding year and 33,593 tons in 1934. These figures would indicate that German producers are

not sharing in the increased world demand for dyestuffs.

Production of coal-tar dyes in the United States, recorded at 54,100 metric tons in 1936, exceeded all previous records and compares with 46,333 tons during the preceding year, 39,626 tons in 1934, and 50,645 tons in 1929 during which year the previous record was established. Exports of coal-tar dyes from the United States aggregated 17,400,000 pounds in 1936 against imports of 3,769,000 pounds. Exports of dyes from the United States go chiefly to Japan, China, and Canada though substantial shipments go to a number of other countries. Analysis shows that shipments are now going forward to about 50 countries each month. United States dye imports originate almost entirely in Germany and Switzerland, each supplying approximately half of the total, statistics show.

While official reports are lacking, Russia is believed to have attained third place as a world producer of coal-tar dyes last year. Soviet reports indicate an output exceeding 25,000 metric tons in 1935, and according to the best information available this was substantially increased in 1936—probably from 15 to 35 per cent if the planned output was attained.

Coal-tar dye production in the United Kingdom aggregated 27,330 metric tons last year, according to the British Board of Trade, which compares with 26,250 tons during the preceding year and 26,304 metric tons in 1929.

Coal-tar dye production in Japan has been increasing steadily in recent years—the total in 1936 reaching 19,368 metric tons, which compares with 17,116 during the preceding year, and 7,796 in 1929. Japan's dyestuffs industry was reported to be suffering from a shortage of raw materials during the early part of the current year—benzol, toluol, cresol and other tar products.

Data relative to Italy's dye output last year are not yet available but it is believed to have been at least as large as in 1934 during which it was reported at about 12,730 metric tons.

The French output aggregated 11,400 metric tons last year against 10,650 in 1935; Swiss production rose from 6,923 to 7,503 tons, estimates indicate; and Polish production increased from 1,800 to 2,000 metric tons.

OPEN FORUM

Rules under which this department of the REPORTER is conducted are as follows:

1. Anyone who has a technical problem on which he would like advice may submit it to the Reporter and it will be published in the first available issue.

2. Any reader who feels that he has a solution of the problem may forward his reply to us and if we feel that the reply is suitable it will be published in a succeeding issue.

3. For each such reply published the Reporter will pay a minimum of $2.

4. In case there is more than one answer to the same question, the one covering the subject in the most complete and authentic manner will be published, or if two answers are sufficiently different both will be published. If two answers are considered equally good, the one first received will be given priority.

5. The Reporter will assume no responsibility whatsoever for the accuracy of the answers submitted—it is simply offering a vehicle for the public expression of its readers' opinions.

6. Both the questioner and answerer must send in his complete name and address. When requested we will publish only the initials or other identifying insignia.

Unanswered Question

41—We would like to know the general principles of the process used in rendering silk transparent. Inasmuch as the process is to be used on rather heavy goods, we believe that one of the newer methods whereby thin layers of fiber have been rendered absolutely transparent is necessary. Information along this line which any of your readers are inclined to give will be highly appreciated.—**Library.**

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

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